UNIVERSITY OF OSLO
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The challenges of implementing a health information system in Vietnam

Master thesis
60 credits

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Abstract

The thesis is based on an action research project where I participated in the implementation of the health information system District Health Information Software (DHIS). The project was a part of the Health Information System Programme (HISP) network that aims for improving health information systems in developing countries.

I participated in the HISP Vietnam project following an action research approach where I conducted fieldwork in Vietnam with the aim of successfully implementing DHIS version 2 in one province while training users and coordinating with the rest of the nodes in the HISP network. I discuss my findings during the implementation efforts based on relevant literature about other HISP-related efforts.

I argue that the efforts in the province are dependant on more participation, resources and commitment from the locals in order for the project to be sustainable in the province.

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I would also like to thank my Vietnamese friends in Hue and Ho Chi Minh City who gave me a warm welcome to their country and taught me a lot about.

I want to thank my fellow Norwegian students who were with me during my time in Vietnam for great support and friendship, and the Norwegian developers in Oslo who offered great support for the Vietnamese implementation.

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1. Introduction

This thesis is based on the ongoing implementation of the District Health Information Software (DHIS) in Vietnam. DHIS is part of the Health Information Systems Programme (HISP), and the author has been involved with the implementation of the software, training of users and coordination between users and developers during fieldwork in Vietnam in the fall of 2006.

1.1 Motivation

I was first introduced to DHIS through HISP in the Information Systems group at the Department of Informatics at the University of Oslo (UiO). Coordinators from HISP had an ongoing course called Open Source Software Development – Java Frameworks in Global Networks which I completed in the fall of 2005. The focus on the course was to help with the development of the DHIS, open source software, and the goals of HISP.

HISP aims for improving health information systems (HIS) in developing countries which is a goal that I found motivating. It was also great to work on a project that actually had been put into use in real life instead of programming on artificial practice assignments.

It was not obvious that my thesis would be related to HISP. I had several available options to me and since I had mixed experiences with programming on DHIS after the course it didn't really compel to me. After a chat with the coordinators I realized I could be a part of the HISP without performing programming tasks. My main objective would involve travelling to Vietnam and helping with the implementation efforts there.

It was a proposition that was hard to turn down. I could travel to a country that was far worse off than Norway and help with a HIS that could ultimately make a difference by bettering the lives of the local population. Travelling abroad to such contexts is an important and exciting part of the work of HISP, and which in the end gave me an experience for life.

1.2 Research Objectives

The basis for this thesis is the author's fieldwork in Vietnam during four months in the fall of 2006. For the fieldwork in Vietnam two research objectives were set as goals to accomplish and one research question was set to answer. Both objectives and the question will be thoroughly discussed and answered.

Primary research objective: *Join in on a team that wants to lay down the foundation of a successful implementation of DHIS 2 in a province in Vietnam.*

I was part of the HISP-project in Vietnam where we implemented DHIS 2 for the first time in the Thua Thien-Hue province. During my stay we implemented DHIS 2 in four out of a total of nine districts. It would scale up to include all nine districts after our departure if the implementation in the first four districts were successful. My objective was to help with the implementation process by installing the software at the districts, provide technical assistance, improve the software if necessary and work closely with the Vietnamese in order to make the implementation process as smooth as possible.

Secondary research objective: *During the implementation process, I was a facilitator, a link between the users and the developers and I wanted to make sure the users got full support from HISP in regards to training, guidance and technical support, and to keep the developers and coordinators in Norway fully informed about the progress.*

I knew that the users in low income countries (LIC) generally rarely have better than basic computer skills. My aim was to teach the users how to use the software and give them enough support during my stay so that they would not need external help in the future. I would also gather feedback from the users and report any issues to the Norwegian team.

Research question: *What are the effects on the Vietnamese team when Norwegian master students arrive in Vietnam to work together with them, and how are the communication tools in HISP utilized?*

I was interested in seeing what effect the Norwegian students had on the Vietnamese team during the time of their fieldwork. Did their activity in relation to the HISP-project increase, decrease or remain the same? HISP also uses a several tools to improve communication across national borders or geographically separated locations. Were there notable differences in the use of these tools?

1.3 Structure of this paper

This thesis is structured into four parts and 12 chapters. Each part includes an introduction to the chapters and the contents. The thesis consists of the following parts:

Part 1: Literature and background

Part 2: Methods

Part 3: The empirical study

Part 4: Discussion and conclusion

Part 1: Literature and background

This part includes two chapters:

2 Literature review
3 Health Information Systems Programme

In this part I'll first give a general description of information systems before I go into information and communication technology (ICT) and the challenges faced in developing countries in regards to that. Since a broad theme in this thesis is health, I look further into background health information, health information systems (HIS) and the challenges with HIS in developing countries. Finally, the literature review concludes with different aspects related to implementing software.

Chapter 3 includes background information about the HISP project and the different versions of District Health Information Software (DHIS).

2. Literature review

In this section I will go through the literature which is a basis for my research. This will form a foundation for the empirical studies and the discussion later on.

2.1 Information Systems

Boddy et. al (2005) describes an information system (IS) as "a set of people, procedures and resources that collects data which it transforms and disseminates".

They further present this figure as the elements and context of a computer-based information system.

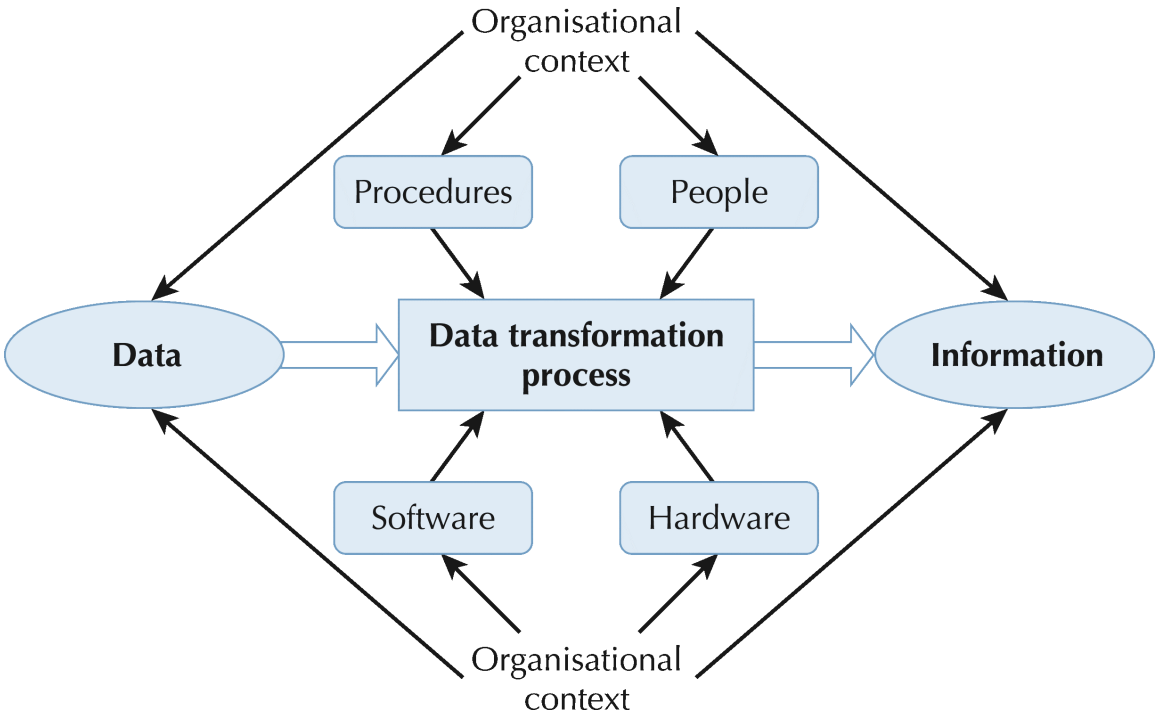

Figure 1: The computer-based information system

We can see that a computer-based information system involves a lot more than hardware and software. This is different than the deterministic view of an IS which says that people have no influence on the course of events and that technology itself will produce the results required (Boddy et. al 2005).

People have informal communication, from gossip to useful information that they share with colleagues. This exists in parallel to the computer based system which shows that

the entire scheme can be seen as a social process. This thesis will look more into the social elements of information systems as opposed to the technical details.

2.1.1 The social aspect of information systems

Kling et al. (2000:49-50) say that a pure technological view on ISs will lead to failures, and gives the following explanation as to why:

"It cannot adequately account for the interactions between ICT, the people who design, implement and use them, and the social and organizational contexts in which the technologies and people are embedded".

Boddy et. al (2005) gives an overview over the different social elements of the computer based information system:

- People

Even the most technically sophisticated IS will depend on people to make it work effectively. This includes staff and managers who enter data or receive the output from it and use the results. It also includes people from supplier or customer organizations who may be dealing with the main organization's IS, or members of the public who visit and uses websites.

- Procedures

When interacting with an IS people have rules or routines that they are expected to follow. For instance, certain procedures must be followed when entering data into the system. These procedures may be flexible or tightly specified in the system itself, and they may require people to use the system or the use of the system can also be voluntary.

- Organization

The procedures and the actions of people using the system are the immediate parts of the IS. They make the organizational context of an IS, so the result of the IS depends on the interaction between people, system and context.

2.2 Information and communication technology in developing countries

One definition of information and communication technology (ICT) is as follows: "*ICT is the catch-all phrase used to describe a range of technologies for gathering, storing, retrieving, processing, analysing and transmitting information. Advances in ICT have progressively reduced the costs of managing information, enabling individuals and organizations to undertake information-related tasks much more efficiently, and to*

introduce innovations in products, processes and organizational structures" (Queensland 2006).

ICT has had rapid development in the western world which has both boosted the economy and made the gap between the rich and the poor countries grow bigger. ICT is seen as a way of reducing this gap and improving the living standard in the developing world.

The Parliamentary Office of Science and Technology (POST, 2006) in United Kingdom mention both the Millennium Development Goals (MDGs) and what benefits ICT can bring to developing countries.

"The MDGs agreed at the United Nations Millennium Summit in 2000, aim to reduce world poverty and improve lives by 2015 […] ICT is seen as a means of achieving many MDGs. One Target specifically relates to ICT aiming 'to make the benefits of ICT available to all'".

"*Information and communication technology can help developing countries tackle a wide range of health, social and economic problems. By improving access to information and by enabling communication, ICT can play a role in reaching Millennium Development Goals such as the elimination of extreme poverty, combating serious disease, and achieving universal primary education and gender equality".*

There are however many challenges that have to be addressed before ICT can be the means of achieving the MDGs. I will present some of these in the next section.

2.2.1 Challenges with ICT in the developing world

One of the main challenges of ICT seems to be the availability of it, and that large numbers of people are left out of the ICT revolution.

James (2005) says how the MDGs measured ICT: "Three indicators were chosen to measure ICT availability in countries and the indicator pertaining to the Internet is defined as the number of users per 100 inhabitants". In relation to that, Prakash (2001) studies how well developed ICT is in Asia: "In terms of internet users (…) only a little above one percent of South Asia's population uses the internet. This indicates the limited outreach and how large proportion of the population cannot take advantage of ICT, making it hard for the digitally backward and developing economies to catch up".

He further emphasizes on the point that large proportions of the developing world still haven't been able to take advantage of the ICT. "Many countries have been left out of the ICT revolution, and even among those that have done well, huge pockets of population remain outside the ambit of ICT".

As Vietnam is very central for my studies it makes sense to look at ICT from the Vietnamese perspective. Vietnam has had, along with many other Asian countries, a

rapid growth in ICT. Prakash (2001) shows that Vietnam had in 1996 1,6% of its population connected to the telephone main lines. In 2000 that figure was 2,7%, while in 2003 (Thang 2004) it was 5,6%. The amount of internet users was 0,13% in 2000 in Vietnam, while in July 2004 the figure was 6,55%. There is no doubt that there is steady growth, and Vietnam is one of the countries in Asia according to Prakash (2001) that had the least amount of ICT available.

Post (2006) looks on why ICT is still out of reach for many groups. They make several points.

- Lack of appropriate products: Products are often not designed to meet the needs of the poor, or those in remote areas. These groups can face constraints such as access to electricity (lacked by two billion people worldwide).
- Cost: Roughly half the world lives on less than four dollars a day. Many potential users are too poor to afford any form of access to ICT.

Thang (2004) points out why there's limited access to ICT in Vietnam by saying that fees are not affordable for the public, and that the budget for developing ICT is inadequate.

Post (2006) continues:

- Education: Even where there is physical access to ICT, many people do not have the technical skills needed to benefit from them.
- Language: Poor literacy is a problem with ICT such as the internet. Of those who can read, many know only a local language, while the internet is dominated by English-language content.
- Human resources: As in many sectors, the migration of skilled ICT professionals from developing to developed countries contributes to a lack of human resources to support ICT.

Even though the importance and benefits of ICT is widely known, introducing ICT to new areas doesn't necessarily give immediate positive effects. Post (2006) says that increasing access to ICT has impacts socially, environmentally and economically, but that it's difficult to demonstrate that they are positive impacts. They list a few points:

- Cultural: In many cases culture adapts to fit technological development, and not vice versa.
- Intellectual property rights: ICT can help disseminate indigenous knowledge (such as herbal medicine). However, by publishing such information on the internet the knowledge of the economically poorer may be exploited with no benefit to them.
- Employment: ICT can take jobs from those who have previously benefited from their specialized knowledge, such as agricultural middlemen who know market prices. ICT does create new jobs, although they are likely to be quite different from the disappearing jobs.
- Environment and health: ICT devices often contain toxic substances, particularly 'reconditioned' (but sometimes obsolete) ICT hardware donated to developing

countries. Increased use of ICT presents challenges for managing electronic waste as well as energy consumption.

In the following section, I will look on Open Source Software (OSS) and how it can be used to combat some of these challenges.

2.2.2 Open Source Software in the developing world

HISP is a non-profit organization and the software (DHIS) it has developed is OSS. OSS refers to the software for which the underlying programming code is available to the users so that they may read it, make changes to it, and build new versions of the software incorporating their changes. It is usually made as a collaborative effort in a community.

Weber (2003) says that developing countries that are struggling with limited ICT budgets look to the potential benefits of using OSS. He further mentions three motivating factors for developing countries to embrace the use of OSS.

- Independence

By deploying OSS a country can potentially save substantial sums of money. By using proprietary software a country may be reliant on major software suppliers in other countries. Countries no longer want to be reliant on single suppliers that may not be focused on the country's interests, and OSS creates an opportunity for domestic talent to participate and compete in the development of local software potentially boosting both employment and economy.

- Security and autonomy

It's been argued that OSS is more robust, reliable and secure compared to proprietary software. The foremost concern of a government is that of public data security and today a major concern is that of malicious viruses causing failures or data loss. OSS also provides more flexibility which better suits the needs of the developing countries. They can participate in the innovation process as the end users in contrast to the proprietary software.

- Intellectual property rights and productivity

Many countries are fighting a combat against software piracy and they see OSS as an alternative to the expensive proprietary software. Not only does OSS provide lower cost, the use and expansion of the software is not limited by the rights of the proprietary software.

2.3 Health Information System

A health information system (HIS) can be defined as "comprising all computer-based components which are used to enter, store, process, communicate, and present health related or patient related information, and which are used by health care professionals or the patient themselves in the context of inpatient or outpatient patient care" (UMIT 2005).

Another definition is: "A health information system is a set of tools and procedures that a health program uses to collect, process, transmit, and use data for monitoring, evaluation and control" (Wilson et. al, 2003).

AbouZahr and Boerma (2005) outline what, in terms of demand, the domains that the health information system should address include:

- Health determinants (socioeconomic, environmental behavioural and genetic factors), and the contextual and legal environments within which the health system operates.
- Inputs to the health system and related processes including policy, and organization, health infrastructure, facilities and equipment, costs, human and financial resources and health information systems.
- The performance or outputs of the health system such as availability, quality and use of health information and services.
- Health outcomes (mortality, morbidity, disability, well-being, disease-outbreaks and health status).
- Health inequities in determinants, coverage and use of services, and outcomes, including key stratifies such as sex, socioeconomic status, ethnic group and geographical location.

There are different types of HISs including routine- and clinical HISs. I will go further into routine HISs which is what the DHIS can be described as.

2.3.1 Routine Health Information Systems

The Routine Health Information Network (RHINO 2003:20) defines routine health information (RIH) as:

"Information that is derived at regular intervals of a year or less through mechanisms designed to meet predictable information needs".

The Potomac Statement (RHINO 2002:3) states the importance of routine information:

"Routine information, whether guiding national or local action, is a necessity for country-led decision-making".

Econ (2005) lists the following examples of RIHS as system for collecting and using:

- Health services statistics for routine service reporting and special program reporting (including on malaria, TB, and HIV/AIDS).
- Administrative data (revenue and costs, drugs, personnel, training, research, and documentation).
- Epidemiological and surveillance data.
- Data on community-based health actions.
- Vital events data (births, deaths and migrations).

Lippeveld (2001) notes current problems with RHISs:

"Most experts agree that routine health information systems in most countries, industrialized as well as third world countries, are woefully inadequate to provide the necessary information support to individual care and public health activities".

According to Lippeveld, at least four reasons are reported consistently in the literature:

- Data on individual health care activities are irrelevant and of poor quality.
- Information on health care interventions is not linked to a reference population.
- Information system management is often heavily centralized.
- Health information system infrastructure is inadequate in most developing countries.

Lippeveld's point about centralization is a central one. RHISs aim to be decentralized giving more power to local managers and districts at all levels. RHINO (2002:3) says that "an effective health information system enables decision makers and managers at all levels of the health system to take the lead in setting priorities, regulating practices, and controlling costs". (Ibid.) also give an example of positive results from decentralization:

"In Kenya, analysis of service statistics formed the basis of budget requests to the district finance board, securing a portion of district development resources to improve the village water supply."

(Ibid.) also mention the strength of the RHISs: "They put data directly into the hands of decision makers and managers at all levels of the health system". With decentralized power and managers at all levels taking part in making decisions it makes for better planning.

2.3.2 Primary Health Care since 1978

The World Health Organization (WHO) and The United Nation's Children Fund (UNICEF) conference in Alma-Ata in 1978 gave birth to the new concept called Primary Health Care (PHC). The vision in that declaration was that by the year 2000 "an acceptable level of health for all the people of the world can be attained through a fuller and better use of the world's resources" (WHO 2006).

The conference urged for development and implementation of PHC throughout the world, especially in the developing countries. PHC can be described as follows (DHS 2004:29):

Community involvement and the use of local human and physical resources to provide a range of curative and preventive services and health promotion measures that are both accessible to and affordable for the local population.
Primary Health Care embraces eight elements:

- Health education
- Food supply
- Drinking water supply and sanitation
- Maternal and child care, including family planning
- Vaccinations
- Endemic diseases
- Miscellaneous diseases and injuries
- Essential drugs supply.

Primary Health Care is geared to the following guiding principles:

- Maximum accessibility
- Utilisation of local resources
- Involvement of the target population in planning and implementation
- Integration of preventive and curative services
- Rationalisation of the health services (appropriate technology, financing and management).
- Inter-sectoral cooperation.

Primary Health Care is not limited to:

- Simple measures (e.g. rehydration and preventive measures)
- Promotion of village health workers and community development
- Activities at the lowest level of health care (dispensaries, etc.).

Primary Health Care also includes the referral hospital.

Werner (1995) asks "Who killed PHC?" Nearly 20 years after the Alma Ata conference he concludes that the high expectations had not been met. He proceeds by giving three reasons as to why:

1. Selective Primary Healthcare

Straight after the Alma Ata conference the countries in the north decided that it would be too costly, and that selective PHC would be more realistic. A "Child Survival Revolution" was agreed which narrowed the focus to just a few indicators like growth monitoring, breastfeeding and immunization. Even though the UNICEF-program reached strong support, the author says that roughly the same amount of children died in 1995 as back in 1978.

"During the 1980s a disturbing pattern emerged in some poor countries: while child-mortality rates dropped, under nutrition and morbidity rates increased".

2. Structural Adjustment Programs (SAPs)

Set in motion by the World Bank and the International Monetary Fund (IMF) these programs transferred public hospitals and health centres to the hands of private investors. This priced the poor out of the market making them unable to pay for health care services. Poor families also tend to get sick the most, which meant that the poorer you were the bigger bills you ended up getting.

"In the Makapawa community-based health programme in the Philippines, health workers found that the money poor families spent on medicines instead of food contributed to child under nutrition and high mortality."

3. "Investing in Health"

In 1993 the World Bank launched a new project called "Investing in Health". The goal of this was to "save million of lives and billions of dollars". It sounded good, but it argued that private healthcare for individuals gives more choice and satisfaction and is more efficient. The new policies of the World Bank included families being required to cover the costs of their own healthcare. This trimmed government spending from comprehensive coverage to a narrow selection of cost-effective measures, and turned the health sector over to private profit-making businesses instead of providing free of subsidized healthcare.

It has received heavy criticism, for instance by Epprecht (1994):

"Investing in Health is not simply reticent about discussing the catastrophic social impact of SAPs (....) since 1986 life expectancy has dropped in at least 11 African countries with SAPs. In Tanzania, female life expectancy alone dropped six years over the period of reform, reversing the impressive gains the country had made since its independence. In the three years since Zimbabwe introduced its SAP, meanwhile, maternal mortality rates have more than doubled. Even in one of the "star pupils" of the IMF (Ghana), child mortality is higher after ten years of so-called economic recovery than it was in the dark days following Nkrumah's socialism (1975), perhaps not too surprising since the population per physician and nursing personnel alike has approximately doubled in that period."

2.3.3 District Health System to achieve PHC

The best way of achieving PHC is through a District Health System (DHS). This was the consensus among the representatives from 22 African countries that signed the Harare Declaration in 1987 (DHS 2004:30).

It has been clear that centralised health systems are no longer in a position to provide even the minimum of care required at all levels, and that major planning and managerial authority should be delegated to decentralised bodies. The district level has a vital part to

play in this new structure. A DHS will include the following advantages over a centralised system (ibid.):

- It is large enough (in business terms) to justify the investment and management costs, especially in hospitals (good cost-benefit ratio).
- It is small enough to be familiar with the relevant demographic and socioeconomic factors, and able to take these into account.
- Participatory planning and organization are more feasible at this level.
- Communication with target groups is easier because of the geographical proximity.
- Management (e.g. supervision) is less complex and thus more effective.
- It is easier to coordinate various programmes and services at different levels.
- Inter-sectoral cooperation is easier, in particular with the agricultural, education, water and waste disposal sectors.

2.3.4 HIS in developing countries

In their conclusion AbouZahr and Boerma (2005) stressed the importance of a functional HIS: "It's not because countries are poor that they cannot afford good health information; it is because they are poor that they cannot afford to be without it".

Lippeveld and Sauerborn (2000) say that "a health information system can not exist by itself but as a functional entity within the framework of a comprehensive health system that offers integrated health services, including curative care, rehabilitative care, disease prevention and health promotion service".

In LICs frameworks like that can be non-existent, which can be a reason for failure alone. Governmental attitude and inadequate financial resources can be the reason why such a framework isn't in place at all according to AbouZahr and Boerma (2005). "Establishing sustained and comprehensive systems of vital registration is an expensive, long-term proposition that carries little appeal for governments with short time horizons".

(Ibid.) briefly mentioned sustainability, and that is a key issue that several authors point out. Braa et. al (2004A) have studied many cases of the implementation of HISP in various countries, and they mentions two broad themes that can be identified in unsuccessful attempts with HISs in developing countries.

- Sustainability

"Sustainability is the challenge to make an information system work, in practice, over time, in a local setting" (ibid.). They say that this means forming the system appropriately to the needs of the users, and then make sure the system persists over time, even after the donors have gone and the funding is over. Once the system fulfills these criterias, it will be sustainable.

Kimaro and Nhampossa (2005) describes sustainability as "the tendency of the system to endure over time and space and is directly concerned with the system to become institutionalized in the workings of the health department".

- Scalability

This is the second challenge from Braa et al. (2004A) and concerns the issue of spreading one working solution to other sites. This does not concern only technical aspects, but how to translate learning processes alongside spreading of artifacts, funding, and people.

The two terms are not independent. The authors say that "scalability is a prerequisite, not a luxury for sustainability of local action". The argument is that local interventions need to be part of a larger network in order to be robust, because networks create opportunities for sharing of experience, knowledge, technology and value.

Funding often comes from external donors as low income countries (LICs) don't have the resources necessary themselves. Kimaro and Nhampossa (2005) mention the relationship between funding and sustainability. "Sustainability of HIS is not possible without adequate resources being allocated according to the needs of users and organization over a reasonable period of time so as to build institutional capacity and decrease the dependency on donors". They also have an example as to what may happen when a donor withdraws from the project. The developer of the HIS for the Ministry of Health in Mozambique (MISAU) departed from Mozambique and went home to his own country after his contract expired. "The system became unsustainable, since there were no technically skilled individuals at the MISAU to take over the vacant position".

In Cuba they experienced similar problems with scalability and sustainability. The key conflict was how to include whole administrative levels and not just a few health centers or municipalities. As the authors say, "Sustainability: Only by spreading throughout whole areas will the system become relevant to managers at different levels within that area" (Braa et. al 2004B).

2.4 System implementation

A lot of implementations of ISs fail, and the reasons for it are usually not pinned down to one cause. Abreu and Conrath (1993) say that one can almost find as many reasons for IS failures as the number of failures themselves, and that a significant proportion of new systems are underutilized, do not meet their potential, or fail to be used at all.

Implementation success can also be contributed to a wide range of different factors, but the most commonly employed measure of implementation success is frequency of use (Yetton et al. 1997). Especially in the earlier stages of implementations, when the innovation is not routinized yet, the only available measure of implementation success is usage (ibid.). Usage of the system is a crucial factor for success for HISP, and the users of the system use it on a voluntary basis. Barki and Huff proposed in 1985 that use is an

appropriate measure of implementation success when use is voluntary (Abreu and Conrath, 1993).

Of other factors that are related to IS implementation successes, (ibid.) say it boils down to having sufficient organizational resources. This implies enough time for both developers and users to do an efficient job, funding and technical skills as the underlying factors of having top management support, a high quality IS design, sufficient designer-user interaction during the development, and motivated and capable users.

Biehl (2007) investigated success factors for implementing global information systems. He went through earlier literature for implementing large scale ISs. All seven sources mentioned top management support as crucial for success. Only three mentioned training. Two mentioned user attitude, one mentioned staff capability and one mentioned financial resources.

2.4.1 Participatory design

Braa et. al (2004A) emphasizes how HISP tries to follow a participatory design approach:

"The primary goal of the HISP research is to design, implement, and sustain HIS following a participatory approach to support local management of health care delivery and information flows in selected health facilities, districts and provinces, and it's further spread within and across developing countries".

User participation has been discussed since the 1970's. Bjørn-Andersen and Hedberg give in 1977 three reasons for user participation in design (Bjerknes and Bratteteig, 1995).

1. Improving the knowledge upon which the systems are built.
2. Enabling people to develop realistic expectations, and reducing resistance to change.
3. Increasing workplace democracy by giving the members of an organization the right to participate in decisions that are likely to affect their work.

The involvement of the end-users is vital to the success of the participatory approach, but the users need to be able to contribute as well as Kimaro and Titlestad (2005) point out: "However, a successful user participation process requires certain contextual properties, such as skilled users and a cultural and political setting that is supportive of user participation, also at the local level", and they continue with mentioning the users: "Typically, users with lack of skills are ineffective in participation and have less influence in design".

There where the users are skilled, both the developers and the users benefit as (ibid.) say: "Skilled users and developers mutually collaborate to create quality computer systems while enabling learning and reducing communication problems".

They continue to sum up the core idea and goal of participatory design.

"In general, participatory design is regarded as an effective approach in systems development processes to overcome challenges such as changing contexts, difficulties of capturing users' needs and problems of achieving system acceptance".

Keil and Carmel (1995) say that it has long been recognized that customer-developer mutual understanding and user participation are important factors in the successful development and implementation of systems.

However, in LICs developers face a lot more challenges than in developed countries. Some problems may be difficulty of communicating, different culture, problems of skilled users, and understanding the users' needs.

Kimaro and Titlestad (2005) see some limitations to the participatory approach when it's used to customize to the users' needs. They mention problems with users having lack of motivation, difficulties with getting the right participants to participate, and that users in LICs don't have the computer skills needed to contribute in an efficient manner.

2.4.2 User training

End-user training (EUT) is crucial for the success of an IS. Without the users being trained properly in their assignments the chance of failure increases substantially. Training is not only important as a mean for teaching the individuals how to perform certain tasks, it's also one of the most pervasive methods of communicating organization goals to the personnel (Gupta and Bostrom 2006).

Training can be done in many ways and it has been heavily researched. One increasingly popular method is the use of e-learning technologies which from 30% in 2004 is expected to reach 60% of all training done by 2009 (ibid.). However, e-learning isn't always applicable in LICs.

Learning outcomes are the results of the training process. Research in educational psychology suggests four categories of learning outcomes. I will just mention the two most relevant ones.

- Skill based outcomes that focuses on the ability to use the target system

This should be the basis and the goal of the training process. The user must be able to use the target system satisfactorily, and the user has to receive training until he or she can master the use of the system.

- Affective outcomes focus on the emotional aspects of the user's behavior. This gives motivational knowledge. They understand what the target system can do for their job and the organization, i.e., the usefulness of the system.

The affective outcomes are crucial with a system that relies on both user participations and where the users are volunteers where they do not get paid for their efforts.

The authors further say that the most prevalent theory to understand participant learning in IS is social cognitive theory (SCT). SCT subscribes to a model of emergent interactive agency. This theory states that it is not just the exposure to simulation, but the learner's action in exploring, manipulating, and influencing the environment that counts. This further emphasizes the importance of user interaction with the system for learning outcomes.

There are different methods of learning, and observational learning is central in literature. Gupta and Bostrom (2006) mention two kinds of observational learning methods that have been differentiated in theory:

1. Observation of others' actions. This involves the trainees watching someone else perform a targeted behaviour and then attempting to reenact it.
2. Observation of self-actions or enactive learning.

The first method of observational learning method can be tied to the rehearsal of model behavior which has been central in IS research. Users will then practice what the instructor has demonstrated, which comes from operant conditioning theory that says that people learn by doing.

As an addition to learning by doing, users can be able to learn from the consequences of their actions. This is useful in an environment that provides feedback based on action, i.e. where you perform training on the site.

Another way of learning is the collaborative learning method which is more an active and group-oriented learning. Users get together and work together to accomplish shared goals. A way of doing this might be one-day seminars where users from different districts get together to share their experiences with the IS.

Technology can be used in different ways in the training. Gupta and Bostrom (2006) mention two ways of using computers to support learning. Learning from computers and learning with computers. If you're learning from computers you are using the computer as the medium for instruction which is the most commonly used. If you're learning with computers the technology is a tool to support teaching and learning.

Shaw et. al (2002) discover in their studies the three most important support factors out of 21 different factors. The top three were "Technical competence of support staff", "IS Staff response time" and "Hardware and software downtime". The two first can be seen as elements of user training.

2.4.3 End-user – developer links

As mentioned in the chapter about participatory design, good communication between end-user and the developer is beneficial for both parties. Keil and Carmel (1995) say that many of the best ideas for new products and product improvements come from the customer (the end-user) of the product.

But how is usually the communication between the customer and the developer? The studies of Keil and Carmel (1995) showed that there were often little direct contact between the end-users and the developers, and that most communication went through intermediaries or surrogates, which in itself led to project failures.

"Intermediaries and surrogates are widely used but poorly rated. When the development managers spoke of the problem they had encountered in relying too heavily on intermediaries or customer surrogates. In many cases, the use of such indirect links was viewed as a significant factor in explaining why projects failed."

Some of the projects they studied showed an overly complicated and unfortunate way of communication between the two parties.

"In some cases, elaborate webs of intermediaries – as many as six layers – were observed between customer and developer".

They proceed to mention why it is better to have direct contact between the customers and developers.

"There are two reasons why intermediaries and surrogates are poor substitutes for direct links between customer and developer. First, intermediaries can intentionally or unintentionally filter and distort messages. Second, intermediaries may not have a complete understanding of customer needs".

Rea (1999) concludes in his studies that technology has increased the gap in how those who develop and implement the technology understand it compared to how those who primarily use it understand it. The gap widens as a result of reaching out to non-technical users. To close the gap and to provide sufficient support for the end-user the implementers needs to understand both "languages", the language of the naïve end-user and the specialized in-group jargon of the implementers and developers.

Kimaro and Titlestad (2005) point out the problems if the communication between developers and users is lacking: It will lead to insufficient capturing of design needs and thus system failures. Intended users and developers need to agree on what is being designed by sharing technological and contextual understandings and available design options.

The direct communication between customers and developers might not always be possible. This is especially the case in global projects like for example the HISP-project. If the communication is troublesome, the developers may choose to be "their own customers" as this example from a project manager interviewed by Keil and Carmel (1995) show.

"The business of eliciting requirements from customers is very difficult. If the requirements are your own requirements, it's a lot easier. Your understanding outruns that of your customer. Eliciting requirements was straightforward because we were our own customers".

3. HISP

In this chapter I will present background information about HISP and provide a brief overview of the different versions of the DHIS.

3.1 History of HISP

Braa and Hedberg (2002) offer a summary of the startup of HISP. After the apartheid regime in South Africa in 1994, the country inherited one of the least equitable health care systems in the world with 60% of the resources being used by the private sector serving 20% of the population. The new democratic government launched the Reconstruction and Development Program to aid the communities that suffered during the apartheid. This involved restructuring the health sector based on a decentralized system of health districts and the development of a new national HIS to support the restructuring.

Strategic management teams were established to develop plans for the reconstruction of the health sector in all provinces, and in early 1995 they proposed a pilot project to develop district health and management information systems. HISP was then established in three pilot districts in and around Cape Town in 1996. Braa and Hedberg (2002) mention two main areas of research in the pilot phase:

1. Development of essential datasets and standards for primary health care data,

2. The development of a District Health Information Software application supporting the implementation and use of such datasets.

Following this, in 1997 the first essential dataset (EDS) was implemented after months of negotiations in the entire Western Cape, including the HISP pilot districts. In 1998 the first version of the DHIS was released and used to capture and analyze monthly data at district, regional and provincial levels in Western Cape. Eastern Cape decided to follow Western Cape's example with using the DHIS software, and a national rollout of DHIS in South Africa followed. This was the beginning of an evolving process which started pilot projects in a number of other developing countries like Malawi, Mozambique, Tanzania, Ethiopia, India and Vietnam.

Braa et. al (2004A) give an overview of the primary goal of the HISP research.

"To design, implement, and sustain HIS following a participatory approach to support local management of health care delivery and information flows in selected health facilities, districts and provinces, and its further spread within and across developing countries."

With this in mind, HISP researchers set a number of key objectives for the DHIS software following Akrich's objectives from 1992 (Braa et. al, 2004A).

- Shift control of information systems from central towards local levels, i.e. towards more equal control between central and local levels.
- Local flexibility and user orientation – it should be easy to adapt the software to local conditions.
- Support for health sector reform towards decentralization and the development of health districts, i.e. integrating the vertical flows at district level.
- Empowerment of local management, health workers and communities.
- Horizontal flow of information and knowledge, based on the principle of free access to all anonymous aggregated health/data information.

These objectives supported the decentralization that was aimed for by the post-apartheid government, and it supported the idea of more power to the users. To emphasize further on how the researcher wanted to accomplish these objectives, Braa and Hedberg (2002) presented a model called the hierarchy of standards.

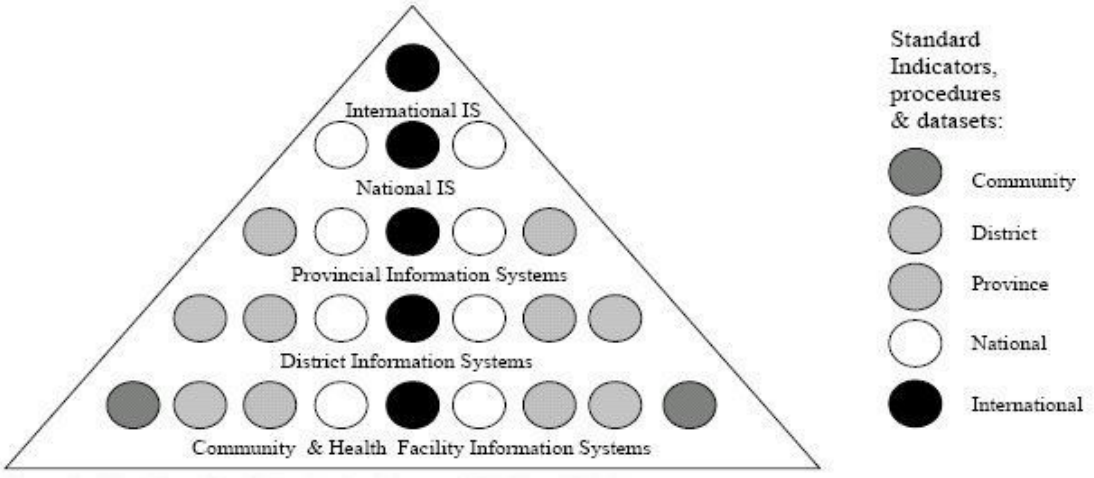

Figure 2: The hierarchy of standards

The idea is that the lower levels of health services needs and uses different, and more, data than what's needed at the higher levels. Braa and Hedberg (2002) gives the following example: "While the health facility needs a register of local tuberculosis patients to ensure proper treatment of each individual patient, the district will only need e.g. the number and percentage of patients fully cured or treatment defaulters".

Through the hierarchy of standards the lower levels will have more flexibility and power in the way they handle and use their information. The structure supports each level to make their own additional standards as long as they also use the standards from the level above. This also ensures that the top level will get the information they require from the levels below.

3.2 DHIS 1

DHIS is the software, the HIS, that is the mean of achieving the primary goal of the HISP research. DHIS is used for collecting routine health information data as well as semi-permanent data (population, infrastructure etc) and it's used for analyzing and reporting the data collected. The data that's collected is defined in EDSs at the given level in hierarchy, or facility, and are used for indicators. Indicators are used and defined in contrast to "raw" data. They monitor priority health targets, such as infant immunization coverage which is more effective than providing just the number of vaccines given (Braa et. al 2004A).

Braa and Hedberg (2002) describe the initial software development of the DHIS software in 1998-99 as a job done by a small two-person team, one system analyst and designer and one programmer hired from a local company. They had close interaction with the users and they focused on having rapid prototype cycles with new versions of the software coming on a daily or weekly basis. During 2000-01 they hired additional programmers from the same company to aid with the development process. As the health staff at different levels started to use it to capture and analyze monthly data, they provided suggestions for improvements (Braa et. al 2004A). With a constant stream of feedback and requests from the users the development team could maintain the rapid prototype cycle which made the staff see constant improvements in the software as all relevant requests was logged and prioritized by the HISP team and eventually implemented.

The prototype cycles slowed down when the use of application increased to ensure stability and more systematic versioning. It was later changed so that experienced users would test the new functionality of the software before releasing a new version (ibid.). Since 2001 the development has mostly been carried out by one developer who has hired external help when needed. Master students from the HISP-network have also helped out, though mostly on the implementation side (Øverland 2006).

DHIS 1 is developed for Microsoft (MS) Access and in Visual Basic for the MS Windows platform. MS Office, especially MS Excel is used for analysis purposes. The software is made available through the HISP-site (www.hisp.info). Even though the DHIS 1 software is free, commercial software is necessary for it to be used. This software will need licenses which is not very affordable in LICs. Shortcomings in the DHIS 1 software were discovered, which eventually led to the development of DHIS 2.

3.3 DHIS 2

Nordal (2006) gives an overview of the process that led to the DHIS 2 development. In late 2003 there were criticism from many central actors within the HISP-project who were unhappy with the current state of the DHIS 1, and it sparked a discussion around the key issues of the DHIS 1-software.

- It was not possible to make DHIS 1 web-based with the technologies it used. All exports between users were done manually, even between users with internet connections.
- It was developed as a standalone application using MS Access and it would only run on MS Windows. A web-based application would be open for all platforms using web browsers as clients.
- DHIS 1 was made using a prototyping approach, which meant adding layer upon layer of new functionality commencing into an overly complex model.
- DHIS 1 used outdated technologies and an outdated programming language.

It was not until the spring of 2004 that the actual work started on DHIS 2 when HISP hired a full time researcher. In June a PhD student joined in and together they started working on what was to become DHIS 2. Their initial work involved an extensive review of potential technologies and frameworks that could be used in the project (Nordal 2006). New essential requirements for DHIS 2 were found.

Firstly, it had to be platform independent. This means that it should support all users, including users that currently were using MS Windows, those that weren't ready or were planning to switch platforms towards open source and those that were already using an open source platform. The last point emphasizes the need of the DHIS 2 not being reliant on commercial software like for instance MS Windows or MS Office. By choosing the latter option it could cut the costs of using the DHIS for health departments.

Secondly, the DHIS 2 should work with most relational databases. As MS Access could not be the standard anymore as it was both too inefficient and proprietary, other database options had to be considered. Nordal (2006) does say that they wished to have a standard database for the DHIS 2 to run on, but that wouldn't always be possible due to local needs, what license they had and what training they had performed.

The last requirement was that it could be used as a web-based application, but that it had to have desktop modules mainly because analysis and reporting tools can be difficult to develop using web modules.

DHIS 2 was also developed using requirements from DHIS 1, so the prototyping approach was set aside for just implementing the functionality from the old system to the new.

3.3.1 The development team

For DHIS 2 there are many different contributors. From UiO there are a constant flow of students, master students as well as doctoral students and professors. UiO has also sent many students abroad, especially to the first DHIS 2-nodes India and Vietnam, to develop the project further from there as well as to achieve a global development team by training and integrating local developers. The local teams can then work on the project locally and customize modules according to local needs.

Part 2: Methods

The chapter in this part is:

4 Methods

This part starts by going through the method of action research before I describe my research approach and the methods that I used as a basis for my thesis. The part concludes by going through the various collaboration tools that I've used in my case study.

4 Research Methods

This chapter will include the theory behind methods for which I used in my studies in Vietnam.

4.1 Action research

The research approach used for my studies has been action research (AR). Kimaro and Titlestad (2005) say the following about HISP and AR:

"HISP applies action research to meet these targets in such a way that health workers and HISP researchers can work together, share knowledge and experiences and thereby become more aware of the options and possibilities for change in the local context, and then collaborate to make change".

AR is an iterative process where clients and researchers collaborate towards a common goal. AR focuses heavily on interaction between the two parties to solve problems and can be defined as a two stage process (Baskerville 1999):

- Firstly, the diagnostic stage involves a collaborative analysis of the social situation by the researcher and the subjects of the research. Theories are formulated concerning the nature of the research domain.
- Secondly, the therapeutic stage involves collaborative change experiments. In this stage changes are introduced and the effects are studied.

This recognizes the fact that an action researcher is actively participating in the setting of the clients in contrast to more standard research where the researcher stands on the outside and looks objectively for solutions.

Baskerville (1999) uses Susman and Evered's five-phase model from 1978 to further describe the process of AR. After a research environment or a client-system infrastructure five identifiable phases are iterated.

- Diagnosing

During this phase the primary problems for the desire to change are identified.

- Action planning

Researchers and clients work together for methods of improving the problems found during the diagnosing phase.

- Action taking

The plan is then implemented in collaboration between the researchers and the clients so that changes are made.

- Evaluating

The outcome of the action taking is evaluated to see if the actions relieved the problems and if the actions were realized.

- Specifying learning

This is an ongoing process where knowledge is gained from the previous steps.

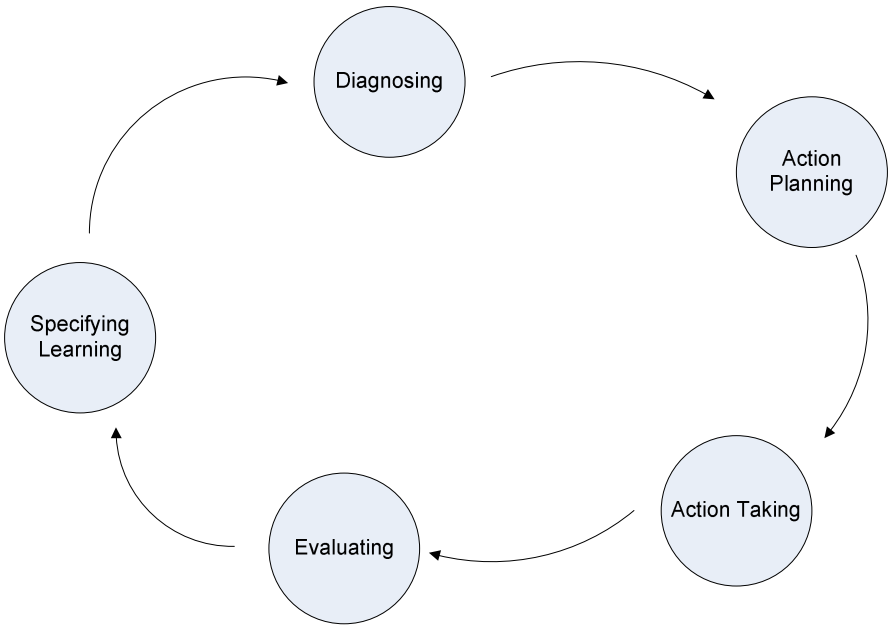

Figure 3: The Action Research Cycle

This model shows that the goal of AR is not to find answers to question as a simple yes or no, but to solve ongoing real life problems while at the same time gaining knowledge from the experiences during the research cycle. The setting must however be in a way that the researcher shares the goals of the client. If the researcher is does not do that the tension between the two parties can destroy the participative validity of the research. Baskerville (1999) continues by stating the ideal setting for in which AR can be performed:

It is a social setting where:

1. The researcher is actively involved, with expected benefit for both researcher and organization.
2. The knowledge obtained can be immediately applied, there is not the sense of detached observer, but that of an active participant wishing to utilize new knowledge based on an explicit, clear conceptual framework.
3. The research is a process linking theory and practice.

The history of AR dates back to the 1940s with the development of action-based social psychology research, but AR was first introduced to information systems in the 1980s (Baskerville 1999). Since the 1990s there have been an increasing number of approaches to AR in the IS domain (Byrne 2005), and the main changes that's taken place over time

is the increasing emphasis on the use of participation in AR (ibid.). In the field of IS, Avison et. al (1999) reported that AR had gained the acceptance at the same level as quantitative studies.

4.2 My research approach

HISP has traditionally used an AR approach for implementing DHIS in several developing countries. This has resulted in a number of students and coordinators travelling abroad from Oslo to help with various aspects of the HISP-project including development, training, coordination and implementation of both new and ongoing projects.

I was part of a three-man group that went from Oslo to Vietnam in late July 2006 and we stayed until late November. I was situated mainly in Hue where I was a part of a team that focused on the implementation of DHIS 2 for one pilot district and later expanded to four districts. This was not the first time DHIS had been installed in Hue, but we were changing their version from DHIS 1 to DHIS 2.

I was working closely with the Vietnamese in Hue, and then mainly with implementation of DHIS 2, training of staff and technical support on both hardware and software. The work mainly consisted of travelling to district offices to provide support and collect feedback from them of which we could evaluate and pass on to the developers in Norway or improve on ourselves if possible depending on what it was.

4.2.1 The HISP team

At the time of my stay in Vietnam the HISP Hue-team consisted of me, and one other Norwegian stationed in Hue working on the Hue-installation. The third Norwegian was stationed in Ho Chi Minh City (HCMC), though not primarily a part of the Hue-team, he spent some time in Hue and provided support when needed. We had in addition two Vietnamese working full-time for the Hue-implementation. One stationed in Hue, and one stationed in HCMC.

4.2.2 Observation

Even though observation in itself undermines the participation of the researcher in an AR-approach, it was still used to gain relevant information at the districts. By observing the practitioners methods of working during training sessions while using the software information that could be valuable for us or the developers was gathered. It also gave me information about their working routines that could later be used by developers for improving the software. Observation could also be used during communication to see how the practitioners interpreted my messages, or it could be used see what practitioners were struggling with in regards to the software.

4.2.3 Training

We performed training with all the users and it was done in cooperation between me and the Vietnamese employee in Hue. Since none at the districts spoke English, we had to transfer both my and her knowledge through the Vietnamese employee. The training was ongoing throughout my stay there as there were always new functionality to show, or that they needed to refresh their knowledge between visits.

4.2.4 Communication with developers

I was the link between the developers in Norway or HCMC and the users in Hue. All the feedback I gathered through our sessions was passed on to the developers to look at, and if it was important I tried for them to incorporate any changes I wanted.

4.2.5 Interviews

I've conducted some informal interviews, usually via mails, with developers and facilitators working with the HISP-Vietnam project. They have mostly been done after my fieldwork in Vietnam to shed lights on certain aspects of the implementation.

4.2.6 Meetings and negotiations

I didn't attend to many official meetings, however when we first arrived in Hue the plan for our four months there was decided in a meeting between the HISP-project team and the local government. It ended in a signed contract (Appendix D).

4.3 Collaboration tools

Throughout my studies I've used several collaboration tools that have been vital in order to get my job done. These are also the primary tools used for collaboration and communication within the HISP-project.

4.3.1 Mailing list

Electronic mail (e-mail) is the primary way of communication in the DHIS-project. The project has several mailing lists that have specific purposes. The most used lists are the developer mailing list and the subversion commit mailing-list (SCM). On the developer list most of the discussion regarding DHIS 2 takes place. Developers discuss everything related to the software, from new features or improvements they wish to implement to bugs in the current releases. This is also the most common forum for discussion between developers and users (or facilitators on behalf of users). The users traditionally sends a mail to this list if there is feedback they want to give, whether it is about new features they wish to request or current issues or errors they are receiving while working with the software.

The scm list sends auto-generated mails by Subversion when a developer commits anything to the central repository. This makes it easy to keep track of recent changes to the project.

There is also a users-list which is in theory the mailing list users will send mail to if they need help or have feedback, but most commonly the developer list is used for this. DHIS 1.4 also has a mailing list for everything related to that version of the DHIS.

4.3.2 Confluence

Confluence is an enterprise wiki that is the largest commercial wiki in the world. A wiki is a website that makes communication easy and where everyone can contribute. It's easy for everyone to add pages and link them together. Its intuitiveness and the dynamics (everyone can edit pages) with administrative control makes it a perfect tool for the DHIS communication and information that is not suitable for mailing lists. Currently, the wiki for DHIS is used for information, guides for implementations and tutorials for technologies and general documentation. It also has a lot of resources including previous work and research done by actors in the HISP-network, contact information, plans for the future and overview of current implementations and projects.

4.3.3 Instant messaging

Clients like MSN Messenger and Yahoo! Messenger provides real time communication is beneficial in numerous ways. Instant messaging (IM) can be used for scheduled meetings across countries and borders when developers at geographically separated locations need to discuss issues. It's also used for daily communication between two developers, for example between the developers in HCMC and Hue.

4.3.4 Subversion

Subversion is an open-source revision control system. It's a system that manages files and directories in a way like windows explorer handles it. There is a central repository in which the files and directories are put into. There are two primary benefits of using Subversion. All the changes ever made to your files are remembered, so if something goes wrong or an error sneaks in it's always possible to get earlier revisions of the same file. The development of DHIS 2 is commenced all across the globe. So having a central repository with the latest changes makes it possible for everyone independent of location to work on the same code simultaneously.

4.3.5 JIRA

JIRA is a bug tracking, issue tracking, and project management system that is developed to make these issues easier for development teams. Features in JIRA include real-time statistics, customizable dashboard, easy-to-use interface, issue navigator, and the possibility to integrate with e-mails and source control.

For DHIS 2 the developers in theory use JIRA to make issue and bug tracking easy and informative. An example can be that a developer doesn't have time to fix a certain bug, creates an issue so he remembers it until the next day, or another developer fixes it in the meantime. JIRA can also be used as a management tool to check out the progress or status of a given project.

The use of JIRA has been very infrequent recently. Even though it happened that we used it in Vietnam, it can't be considered as an important tool for HISP anymore.

Part 3: The empirical study

This part includes the following chapters:

First I will give relevant background information about Vietnam before I account for the details around the HISP-Vietnam project. I will further narrow it down to the implementations in Hue. The next chapters go in the depth of various aspects of one of the Hue-implementations.

5. The Vietnamese context

This chapter will include background information about Vietnam which will give better understanding of the Vietnamese context.

5.1 Geography and demographics

Situated in South-East Asia along the South China Sea, Gulf of Tonkin and Gulf of Thailand Vietnam is bordering to China, Cambodia and Laos. With its 331.688 square kilometres it is about the size of Norway. Vietnam has a population of nearly 84 million people, making it the 13th most populous country in the world. Most of the population is young, nearly 30% being between ages 0 and 14, and only 5,6% being older than 65 years of age (Wikipedia A 2007).

5.2 History and politics

Vietnam has a troubled history. They lost their independence in 1858 to the French, who kept control until Japan's invasion of Indochina in 1940. In 1946 Japan surrendered to Chinese nationalists in Northern Vietnam, and in the meantime the emperor had abdicated to Ho Chi Minh and his Viet Minh (Vietnamese Allied). Ho Chi Minh was a trained communist revolutionary who came back to Vietnam in 1941 after many years in Moscow. After Japan's fall in the north The Democratic Republic of Vietnam (DRV) was founded and the country gained its first constitution.

In Southern Vietnam France tried to regain control in the First Indochina War which lasted until 1954. In the Geneva Conference France's rule was ended and Vietnam was partitioned into two states at the 17th parallel. The Republic of Vietnam in the south was supported by the United States, and Ho Chi Min and his DRV reigned in the north.

An election for a unified Vietnam was promised by the Geneva Accords, but the USA and the government of Southern Vietnam refused as they believed Ho Chi Minh would win the elections. What followed was the Second Indochina War, better known as the Vietnam War. The Americans withdrew in 1973 with the Paris Peace Agreement after deeming the war as unwinnable. The North continued the war and defeated the South in 1975, and in 1976 the Socialist Republic of Vietnam was founded.

Only two years later the Vietnamese invaded Cambodia to defend the ethnic Vietnamese against massacres by the Chinese-supported Pol Pot regime. China retaliated in 1979 by invading Vietnam in what is known as the Third Indochina War. Vietnam withdrew their troops from Cambodia in 1989 (Wikipedia C 2007).

The Social Republic of Vietnam remains as a one-party state, with especially journalism and political dissent tightly controlled, and there is no legal opposition to the Communist

Party of Vietnam (CPV). A new constitution was made in 1992 reaffirming the role of the CPV (Wikipedia B 2007).

5.3 Economy

The Vietnam War left the economy shattered, and it was not before the reform in 1986 called Doi Moi that things turned for the better. It was an economic reform that encouraged private ownership in industry, agriculture and commerce. This resulted in a growth in the gross domestic product (GDP) by 8% annually from 1990-1997. The last few years Vietnam's GDP has had a growth of around 8% and they are aiming for 8,5% in 2007 which makes Vietnam's economy the second fastest growing in the world. (Wikipedia D 2007)

Vietnam joined the WTO in 2006 and established trade with their old enemy USA in 1995. Deep poverty, the number of people that live on below $1 per day, has declined dramatically. (Wikipedia A 2007).

5.4 Health System

Vietnam adopted the idea of PHC quite early, and the WHO was in fact inspired by Vietnam when they came up with the Alma Ata declaration in 1978. From the mid-50s the motto was "prevention is better than cure", and the goal was having health services free and accessible to everyone, even in remote areas. By teaching people the basics about hygiene and health there was a considerable reduction in preventable morbidity and mortality from communicable diseases. The commune health stations were financed by agricultural cooperatives (WHO 2002).

In the post war period from 1975 to 1989 Vietnam no longer got sufficient financial aid from socialist countries, and they were isolated from the world community because of the American embargo. There was no longer money to operate the health stations, so even though the services still were free, there were no services to get.

Doi Moi worsened the situation when it was put into effect in 1989. Agricultural cooperatives collapsed which led to a cut in financial support to commune health stations. The workers were no longer paid and the conditions worsened due to no finances for maintenance. To seek income, both public and private services introduced user fees which weakened their trust among the public. Services and quality of the health care were reported as poor. In 1994, the government took over responsibility to pay the staff and together with development aid yet again being available, the situation finally turned to the better. As an example, the percentage of population that lived on less than 2100 calories per day fell from 58 percent to 29 percent between 1993 and 2002. (IMF 2005).

The main challenges of Vietnam are the struggle against high maternal and child mortality rates, malnutrition and anemia (WHO 2002).

The Vietnamese public health care system has four levels, central or national, provincial, district and commune. At central level there are various national and regional research institutes, 30 general and central hospitals, education institutions and pharmaceutical and health equipment companies. At provincial level they develop annual health plans for its province and monitor their hospitals. At district level, they focus on managing the health care at district and commune level. Most preventive and primary health care is given at the commune level (Nguyen et. al 2004).

5.5 ICT in Vietnam

The ICT in Vietnam is like the rest of Vietnam in rapid growth. In 1986 there were 80.000 fixed telephone lines where as today there are several million lines. The objective for 2010 is having 15 phone lines per 100 people, which equate to, with the current population, 13 million phone lines. The telecom business in Vietnam is the second fastest growing in the world, and 25-30% of the telecom market is non-state owned. This is not the case for internet (Gicale 2003).

The internet came first to Vietnam in 1997 (ibid.), and all 64 provinces in Vietnam have access to internet through dial-up, but it's more tightly controlled than the telecom market. They government controls all the data flow in and out of Vietnam, and there have also been reports of arrests based on communication on the internet through e-mails that's against the ideas of the government (Amnesty 2007). The goal for 2005 was 12% user coverage on the internet, almost double of the figure for 2004 (Thang 2004).

The revenue that Vietnam generates from IT production also skyrockets. It went from $230 million in 2000 to $690 million in 2003, but still they only had 20.000 out of 40 million total workers in the IT industry. It's estimated that they will need over 100.000 workers by 2010 to meet demands, and to reach that goal they receive help from Japan, and the government send students abroad for education (Gicale 2003).

In 2004 the Vietnamese government approved a master plan for applying and developing OSS in Vietnam (Vietnam OSS, 2004). The plan included three objectives:

1. Accelerating the application and development of open source software (OSS), enhancing copyrights protection and cutting costs of software purchase, promoting the development of Vietnam's information technology in general and software industry in particular.
2. Forming a base of competent technical experts who master advanced technology and leverage their creativity in OSS application and development.
3. Creating some typical IT products that respond particularly to domestic conditions and practical needs of OSS development.

These objectives would be achieved by strictly enforcing copyright protection, improving the social awareness of OSS of the public, installing OSS in education systems and provide funding for OSS development.

5.6 ICT in Health

Vietnam and its Ministry of Health (MoH) use The National Health Management System for assessing the health situation in Vietnam for planning, monitoring and evaluating health care activities and evaluating the health sector (Heywood 2005). They've defined 121 indicators, but the amount of data collected through the system and how it is collected is still not satisfactorily (ibid.).

The plan according to Heywood (2005) is that every district should have 10 computers and every commune should have one computer. It does not seem very realistic at all based on my research where most districts had one computer, but there were several districts that would need hardware purchases if we were to work with them.

The 121 indicators are largely ignored and much more data is collected than what's needed. Each of the 24 vertical programs that data is collected through goes ahead and implements the dataset they want, and there is no coordination between the programs or between the MoH and the programs. This forces duplication, data overload and poor data quality. There is no use of tools for analysis of data, as they have none, and the vital component for improving quality of data, feedback, is non-existent.

6. The HISP Vietnam project

This section will include a brief history of the HISP Vietnam project up until my arrival in Vietnam.

6.1 History of the HISP Vietnam project

The initial contact between the Vietnamese government and HISP happened in July 2004 when the Vietnamese contacted a HISP project leader because they were interested in HISP and especially the OSS aspect of HISP given the increasing focus for OSS in Vietnam (ref. 5.5).

A formal agreement between the two parties was signed in the fall of 2004 allowing HISP to implement DHIS in the three cities of Hue, HCMC and Hanoi. The implementations would first be done in pilot districts before scaling it up over larger areas.

HISP has now gone through three versions of the DHIS software in Vietnam in three different implementations, the third one still being ongoing.

6.2 First Implementation

The first implementation started as a period of four months in HCMC in two pilot districts. It went from December 2004 through March 2005. After this period HISP rolled out the software in more districts and hospitals to 17 districts at most. The version installed was DHIS 1.3 and the implementation effectively ended in the fall of 2005 when the use of the system faded.

Øverland (2006) mention three crucial elements that negatively affected the implementation efforts. The lack of a working report generator made the districts unable to process output from the system. There were problems with computer failures, virus attacks and Vietnamese fonts. Lastly, there was lack of personnel to perform training and initialize learning processes which left health workers with lack of computer skills on their own with a system they did know have sufficient knowledge about.

In Hue, the first agreement (Appendix B) was signed in the fall of 2004. It involved implementation of DHIS 1.3 in all 9 districts in Thua Thien-Hue province, and it put a lot of responsibility on the shoulders of the Hue Province Health Department with training, maintenance and troubleshooting.

The software was implemented in October 2004 in two pilot districts. The goal was to scale up to all districts from March 2005, but they suffered some problems related to both databases disappearing in a Microsoft Office update which led to DHIS 1.3 being replaced with DHIS 1.4 from March in the second implementation.

6.3 Second Implementation

After the DHIS 1.3 implementation, a new effort with DHIS 1.4 started in November 2005. The plan was to implement the system in pilot districts in HCMC, Hanoi and Hue as a joint venture between the MoH and HISP. DHIS 2 was scheduled to be installed in December 2006.

The implementation itself was set to two pilot hospitals in HCMC that had previously been engaged with the first implementation. The implementation was over already in December 2005 for a couple of reasons: DHIS 1.4 used proprietary technologies, and DHIS 2 came along really well so that there was no point in a long term plan for DHIS 1.4 if it was to be replaced anyway.

In Hue, a new agreement was signed in March 2005 (Appendix C) which aimed at a full installation of DHIS 1.4 in all nine districts by the end of 2005. This time, HISP had a local software company on their side which both provided a working space for a Norwegian master student that arrived in March and a working place for the student and a master student from Hue University of Science and Technology. After graduation the master student would become a full-time employee of HISP in Hue. These two along with one employee of the local software company were in charge of the local implementation.

The health service in Hue was asked to provide computers and printers for the remaining seven districts, but other than that they had a lot less responsibility than in the previous agreement. The Norwegian master student had to change focus from implementation to making a report solution as it was needed. So, by July 2005 when the student went home to Norway, DHIS 1.4 was still only implemented in the two pilot districts. It was eventually implemented in five districts total, and finally relieved by the implementation of DHIS 2 in August 2006.

6.4 Third Implementation

The third implementation, the move from DHIS 1.4 to DHIS 2 started in HCMC in April 2006. One district and one health program was chosen as a pilot district. The focus was that users received adequate training, and it was later approved by the manager of the health program.

The second phase lasted for three months from May 2006. Two more districts and two hospitals were chosen. The final phase, in August 2006, included all districts of HCMC. In parallel to the third phase of the HCMC-implementation DHIS 2 was rolled out in one pilot district in Hue, which later was expanded to three more districts.

6.5 Time Line

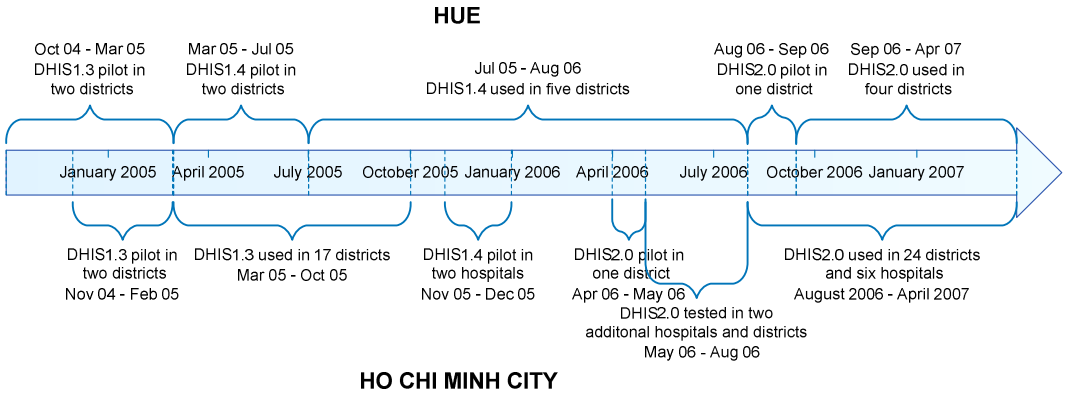

Figure 4: Timeline

7. The Hue context

This chapter will focus more on DHIS in Hue and its setting for the implementation I participated in.

7.1 The setting

The following paragraphs give some background information about Hue and the setting that the software had to accommodate.

7.1.1 Thua Thien-Hue

Thua Thien-Hue is a province with 1.1 million people in an area of 5.054 square kilometers (Wikipedia E 2007) in central Vietnam consisting of nine districts. The city of Hue is the capital and it's located in the centre while the other eight districts lies in the surrounding areas. It was decided initially that we would install DHIS 2 in five of the nine districts because some of the districts have very poor infrastructure which makes them hard to travel to. This was later changed to the four districts Huong Tra, TP Hue, Huong Thuy and Phu Loc.

7.1.2 Organization structure

The organization unit tree in Thua Thien-Hue has four levels. The province of Thua Thien-Hue is naturally on top. Below the provincial level follows nine districts which have a number of wards or hospitals under them. Hospitals can also have wards that report up to them.

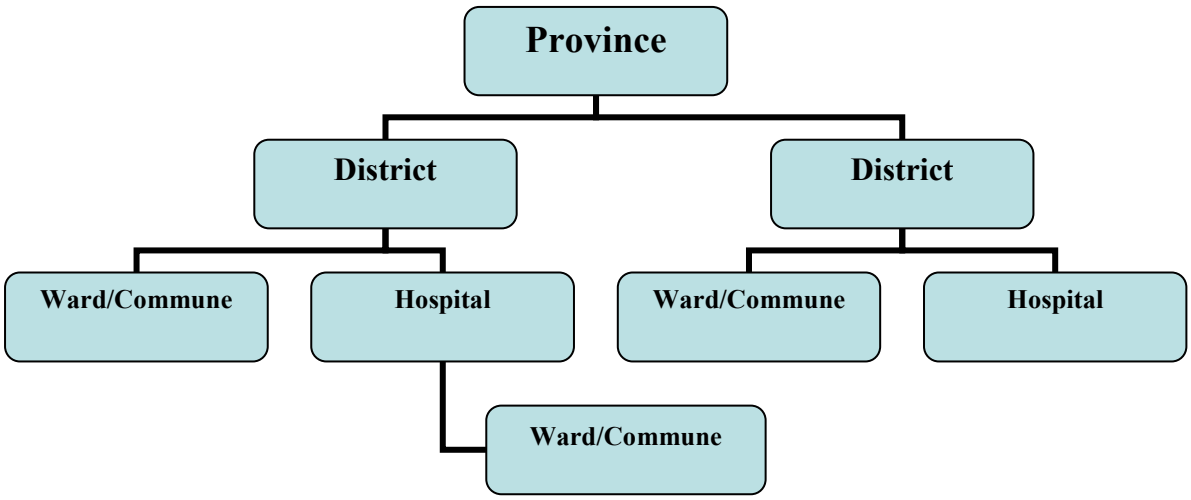

Figure 5: Thua Thien-Hue organization structure

7.1.3 Reports

The reporting system in Vietnam is reasonably well defined. The commune health stations send six reports to the district health centres, which are required to send 15 reporting forms to the provincial health offices in Vietnam. The provincial health offices send in turn 16 reports to the MoH.

Earlier implementations of DHIS had failed in Vietnam due to the lack of working report generators (ref. 6.2). It was therefore crucial that we had a working report generator. The work on that started when we first came to Hue, and it was set to finish at phase 3 (ref. Appendix A). For reference, these are the 15 reports that we had to focus on supporting.

Name	Topic	Reporting frequency
B1	Population	Half-yearly
B2	Birth and deaths	Yearly
B3	Finances	Yearly
B4	Finances (more detailed)	Yearly
B5	Hospitals and offices	Half-yearly
B6	Staff	Yearly
B7	Pharmacy	Half-yearly
B8	Equipment	Yearly
B9	Children program	Quarterly
B10	Mother program	Quarterly
B11	Family planning	Quarterly
B12	Treatment	Quarterly
B13	Diseases (e.g. malaria)	Quarterly
B14	Transmittable diseases (e.g. flu)	Quarterly
B15	International Code for Diseases (ICD). This report has six data elements for 500 diseases, giving a total of 3000 rows to be filled in.	Yearly

Table 1: List of reports

7.1.4 The report module

There was a growing need for a report module in Vietnam as the DHIS 1.3 implementation failed due to the lack of a working report generator. DHIS 1.4 did not have report functionality suitable for the needs of Vietnam.

The current report module has been developed by a Norwegian master student after gathering requirements from Vietnam. It was included in the DHIS 2 installation package in mid-2006 in time for the third implementations in both HCMC and Hue-implementations.

The report module was developed based on local demands in Vietnam has later been used in other countries in the HISP-project.

7.1.5 The Hue report-tool

When we arrived the report module had not been fully customized for the use in Hue, so there was need for a Hue-specific report tool to generate the 15 reports (ref. 7.1.3) required in the software. This was a job that was undertaken as soon as we arrived in Hue, and the first report was ready at the first implementation.

TÌNH HÌNH CHĂM SÓC SỨC KHOẺ BÀ MẸ — Biểu số 10

Đơn vị báo cáo: Xã Thuỷ Tân — Thời điểm: 2007-01-01 - 2007-01-31 — Trang 1

TT	Cơ sở y tế	Tổng số lần khám phụ khoa	Tổng số người khám phụ khoa	Tổng số các vợ chồng chưa vô sinh	Số mới phát hiện có thai trong kỳ	Tổng số có thai trong kỳ	Lần khám: Tổng số	Lần khám: Trong đó khám lần đầu	Số phụ nữ được tiêm phòng UV2+	Lần khám thai: Tổng số đẻ	Lần khám thai: T. đó khám thai trên 3 lần	Lần khám thai: Nơi đẻ: CSYT nhà nước	Lần khám thai: Nơi đẻ: CSYT tư nhân	Lần khám thai: Nơi đẻ: Tại nhà	Lần khám thai: Nơi đẻ: Nơi khác	Số bà mẹ đẻ không do cán bộ y tế đỡ	Đẻ thường	Mổ đẻ	Forceps	Khám sau đẻ: Tổng số bà mẹ	Khám sau đẻ: Trong đó khám tuần đầu	5 Tai biến sản khoa: Băng huyết: Mắc	Băng huyết: Chết	Sản giật: Mắc	Sản giật: Chết	Nhiễm trùng: Mắc	Nhiễm trùng: Chết	Uốn ván: Mắc	Uốn ván: Chết	Vỡ tử cung: Mắc	Vỡ tử cung: Chết
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	Tổng số	2	3	5		10	2	0	0	4	13	44	22	0					0	11	23	1		2	0	0	0	33	2		

Figure 6: Example Report of B10.

7.2 The third implementation in Hue

HISP has implemented DHIS in Thua Thien-Hue province three times, with three different versions of the software, three different contracts with the local government, and with three different implementation teams. The following paragraphs will provide information about the initiation of the third implementation.

7.2.1 Initial contact

Even though DHIS 1.4 was installed in the district we needed permission before we could start implementing. 4th of August we had a meeting between nine representatives of HISP (three Norwegian master students, one employee of HISP in Hue, one employee of HISP in HCMC, the HISP-Vietnam coordinator, one coordinator from UiO, one representative from the Hue health service and one representative of the Vietnamese MoH) and the local government. Since the meeting was in Vietnamese it was difficult to understand what was being said, but it ended in an agreement in form of a contract that both parties signed (Appendix D). It gave us safety as we had now signed papers that made us able to do our work and install DHIS 2 without fearing interruptions from the government.

7.2.2 The agreement

HISP committed to upgrade the software from DHIS 1.4 to DHIS 2 and to include all nine districts and all 15 reports (ref. 7.1.3) over the next 18 months. There was however no support from the local software company this time around. HISP committed to buy a computer and two printers for two districts while the health service was going to buy four computers for the last four districts. The implementation efforts in Hue would be supported by a HISP-employee in Hue in addition to two Norwegian master students.

7.2.3 The implementation plan

A plan for the implementation (Appendix A) was made when we arrived in Hue. As previous plans, it involved pilot districts and scaling with time. The plan focused on on-site training and frequent revisits to all districts with constant software improvements.

7.2.4 The implementation team in Hue

The first implementation was started 16th of August when we installed DHIS 2 in TP Hue district. At this point in time we were six representatives of HISP in Hue. One coordinator from the University of Oslo, myself, two additional students from UiO, one employee of HISP in Hue and one employee of HISP in HCMC. All six of us participated on the first installation of DHIS 2 in attempt to show that we were being serious about making this implementation.

Mostly we were two Norwegian students in Hue and the one employee of HISP. One the employee from HCMC worked on the Hue-implementation from HCMC, while the third Norwegian student supported us from HCMC when necessary. We also had on Vietnamese woman from the provincial office that joined us for most trips to the districts.

7.2.5 The first software installation at a district

The first thing we did when we arrived at a new district was to check the capacity of the computer at the districts. They all had sufficient processors, but both Phu Loc and Huong Tra lacked ram to be able to run DHIS 2. To run DHIS 2 in a satisfying manner 256mb ram was needed, and both these districts had 128mb ram. We solved this by buying an additional piece of 256mb ram which we installed in Phu Loc. We then took their spare 128mb chip and put it in the computer at Huong Tra.

After we had concluded that the hardware was good enough, we proceeded with the installation of the software itself. As the installation package had been put together earlier and tested on multiple machines it usually installed well on the first attempt.
When the installation was completed we proceeded by testing it. Demanding tasks like generating reports and pdf's determined if we needed a better computer for it to work. Mostly the results were satisfactory and we proceeded to the user training. This was a task split between our employee in Hue and the Norwegians at the site. The employee had to do most of the work explaining it because of the language barriers. We watched

closely and came with input through her when we saw something that was worth mentioning. At this phase we also focused on getting as much feedback as possible from the user.

When the user had received sufficient training we told her to input data and gather feedback until next time. We noted what was needed of improvement in the software based on anything that might have occurred during the installation.

7.2.6 The flow of the installation process.

The process of implementing DHIS 2 in the field involves more than just the software installation at the computer at the district. It involves several steps and can be compared to the waterfall model in software engineering. The waterfall model (Sommerville 2001:45) determines five stages of the software life cycle.

1. **Requirements analysis and definition**

A system specification will be made after consulting the system users about what the system will do.

2. **System and software design**

An overall system architecture is made based on the system specification.

3. **Implementation and unit testing**

The software design is realized as a set of programs or program units. Unit testing verifies that it meets its specification.

4. **Integration and system testing**

The individual programs are integrated and tested as a complete system and it's delivered to the customer if the testing succeeds.

5. **Operation and maintenance**

This is the longest phase. The system is installed and put into use. Maintenance involves correcting errors which were not discovered earlier. New requirements are discovered.

So, what does this have to do with the installation process of DHIS 2? It has a fairly similar life-cycle and it can also be based on five separate stages.

1. **Requirements for the installation package**

We have to decide what should be in the latest installation package. Since we decided to use trunk it may seem straightforward. The trunk refers to the file tree under revision control in Subversion in DHIS 2 that hold the newest functionality. It happened that we needed to use earlier revisions of trunk in case there were changes that caused errors in the software. We also needed to decide on the version of the database as there were some changes on the database structure during our stay causing inconsistencies between districts.

2. **Making the installation package**

HISP-Vietnam (2007:20) made a detailed explanation of making a DHIS 2 installation package. In short, we used a tool called Installer2GO (http://dev4pc.com). It is free, and it suits the needs that we have to make an installation package.

3. **Testing the installation package**

We had to make sure that the new installation package worked so we tried to run it on as many computers as possible. In the beginning we used the computers at our hotel because with their poor hardware we could simulate how it would run in the districts. We also performed testing on our laptops.

4. **Installation at the district**

This has been described in detail earlier (ref. 7.3.4). We brought the installation package with us on both our laptop and a pen drive for safety. Users were trained for the first time and initial feedback is received.

5. **Operation and maintenance**

This is perhaps the most crucial of all phases. During this phase we ensure that the system is being used and working correctly by doing revisits. New requirements are discovered as users have more feedback or that we notice something that's not working properly. Additional training of users is performed if necessary.

7.3 The Districts

This section will include a brief overview of the different districts we visited during our stay and when we visited them.

7.3.1 TP Hue

TP Hue was as mentioned the first district to get DHIS 2 and as according the plan (ref. Appendix A), our initial pilot district. It was first visited 16th of August, then later at the 18th of August and again on the 23rd of August. We wanted to go in September, but we were denied due to the employee at the office being busy with a course she was taking. Last visit was 27th of October. Travelling to the TP Hue was fairly quick, only 10 minutes by car.

TP Hue district had one employee that was in charge of entering data, and during our visits we didn't see anyone else being capable of working with the computer. The hardware was sufficient.

7.3.2 Huong Thuy

We visited Huong Thuy on four occasions. First visits were on 13th of September and 20th of September. The crucial period was in October and November, but we only had two visits during this time due to us not being able to acquire transportation. The two last

visits were 19th of October and 16th of November. It took about 30 minutes to get to Huong Thuy by car.

Huong Thuy had one person entering data, but also one more person that seemed to provide some assistance during data entering. It was however always the same person that entered data. Huong Thuy district had best hardware of all the districts.

7.3.3 Phu Loc

This district was only visited twice due to the aforementioned problems with acquiring transportation. We went there the 19th of October and the 16th of November. Phu Loc was the district that was furthest away since it took one hour to get there by car.

Phu Loc also had only one person entering data, and their hardware was not sufficient at first for the installation of DHIS 2.

7.3.4 Huong Tra

Huong Tra was visited twice, 18th of October and 15th of November. It took roughly 30 minutes to get there.

As all the other districts, Huong Tra only had one person that worked with the computer. The hardware was also non-sufficient.

7.3.5 Summary of districts

District	Travel Distance	Times Visited	Employees to enter data	Sufficient hardware
Huong Thuy	30 minutes	4	1	Yes
Huong Tra	30 minutes	2	1	No
Phu Loc	1 hour	2	1	No
Hue City	10 minutes	4	1	Yes

Table 2: Summary of districts

7.3.6 Detailed organization unit tree

The following organization unit tree provides a more detailed description about how large of an area the district offices cover.

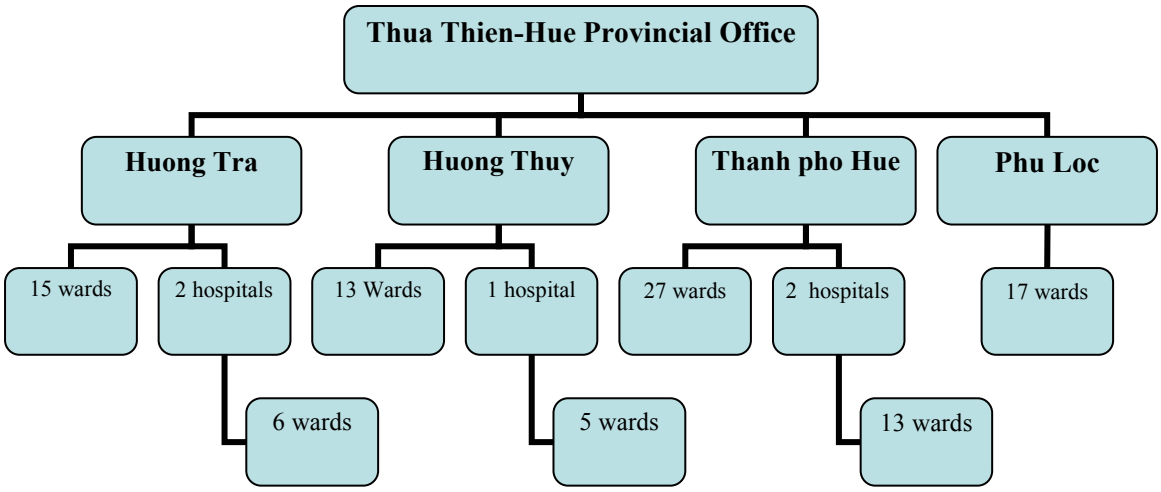

Figure 7: Detailed organization tree over the four visited districts

8. Discoveries during the Hue-implementation

In this chapter I'll highlight my findings from the Hue-installation. This is all based on personal experience with the visits to the four districts we visited during the four months in Hue.

8.1 Issues encountered

We knew we would encounter some issues, or problems, during our stay, but possibly not as many as we did encounter. The seriousness of these problems differ, but I believe it's worth mentioning them all.

Insufficient hardware

We had been warned that there could be problems with hardware at some districts. The districts we were going to were however picked both because of their relative closeness to Hue, and for their hardware. Two of the districts had insufficient hardware to run DHIS 2 in a satisfying manner. We arrived at Huong Tra on the 18th of October, and their computer had an Intel Celeron 2.4 ghz processor, but only 128mb ram. That they prioritize wrongly when purchasing hardware seems to be a typical problem in Vietnam. All the computers we worked with during our stay had powerful processors but next to no ram. We went ahead with the installation at Huong Tra, even though it had only 40mb physical ram available with no programs running. DHIS 2 was determined to be quite useless with that amount of memory available, and we felt we wasted a lot of time for a lot of people because of this. On the trip back to Hue we picked up an additional 256mb ram since we had our first visit to Phu Loc the following day. Phu Loc also had 128mb ram, but the installation of the chip we bought was successful.

Infrequent visits

For every revisit to a district we had to go through a rather tedious procedure. Unfortunately we couldn't just go at any given moment, and this hurt the installation process in some ways as there were times when we couldn't go for various reasons. A time and date had to be agreed upon with the district. After that we had to get a car with a driver from the health district. From the end of October to mid-November we were unable to acquire a car for close to three weeks because of a possible typhoon that was incoming. One typhoon hit and devastated the province in mid-October, and to prepare for the new typhoon every car available at the health district had to be ready to transport medicines and equipment to the areas that could be hit. Luckily it changed direction towards Hong Kong and faded in the ocean. This didn't change our luck with registering cars, as the health service then required all the cars for test drives out to the districts for over a week. It was something we just had to accept even though we tried hard to acquire transportation during this time, but our efforts proved unsuccessful.

The timing was especially bad as we took a three week vacation in the beginning of October. This left most districts with only one visit from us from the start of October to the middle of November which was far from ideal. Due to us leaving towards the end of November we only had time for one more visit to the districts between having available transportation and our departure.

No stable release of the software

We had to make our installation packages based on the trunk. When checking in new code to Subversion it's supposed to be bug free and working, but that will not always be the case.

Early on we decided it was a good idea to use trunk instead of released milestones because we simply didn't have any other options. There had been some time since the last release and the current version of that trunk at that time had a lot of important features we needed. The use of the trunk could at times be problematic. At one point we weren't able to make a new and improved installation package for a district in time since someone had committed an error so it was impossible to actually build the trunk.

When we used trunk we always had the latest fixes and features available. We could not let the districts wait for a long period of time until the next release, and with the version from the trunk they could see steady improvement including new reports for every visit and issues we had fixed based on their feedback from earlier visits.

The decision of using trunk and the time for visits to the districts led to every district having different versions of the software and different versions of the database as well as there were changes in the database structure during our stay. Having different versions was problematic even when we only had four districts to take care of. If we had implemented like this in nine districts I don't see anything else than major problems with version controls erupting.

Working environment

We never had a proper place to perform our daily work. In the meeting we had with the local government 4th of August, myself and the other student's working place were discussed. It was in our interest that they provided an office for us at the health service, but it was easier said then done. We got it in our contract (Appendix B), but to get an office some paperwork needed to be done for security clearance. We had to send our passport numbers away, and finally after one month and two weeks, and several visits to the police station by our Hue-employee, we were finally allowed to work at the health district. However, it wasn't really an office. We were placed by a desk that was too tall and that was quite dirty. The internet was slow and unstable, and they were busy with construction work right outside the open door. No air condition meant that it was hot and humid inside, roughly 30 degrees, and they only had working hours between 8-11 and 13-17. It wasn't an ideal working situation, and even though it was in Vietnam, a totally

different culture, it was so much worse than working from our hotel that we usually only went back to the office for showing our interest and talking to people.

Dependency on the users

When implementing software like DHIS 2 we have to hope that the users are willing to learn and willing to work with it. In general the users seemed at least decently eager to learn the software and find their way around it, but we do have reasons to believe that they don't always understand the value of using it. It occurred that no data had been entered between visits, and we usually didn't get any good reasons as to why. They may have been a bit reluctant to tell us why, as I believe it was not because of the software. It could have been motivational or time issue.

At the hospital in the city of Hue the worker in charge of the entering of the data also went away for several months due to a course she was taking. It meant that she didn't enter data and that we couldn't go there as often as we wanted to upgrade the software. No districts had more than one person capable of entering data (ref 7.3.5). When that person was gone, all progress in that district completely halted, and there was not much we could do about it.

Computer security

The users at the districts weren't very computer knowledgeable. As an example, all the computers at the districts were fairly weak so the monitors ran in 800x600 resolutions. DHIS 2 was designed for 1024x768 or above resolutions and wouldn't work properly in lower resolutions. Parts of the organization unit tree were not visible at lower resolutions. We changed the resolution to 1024x768 at Huong Thuy since they had a powerful computer there. We thought everything was fine until we received a phone call in the car on the way to Phu Loc.

"The icons on the monitor are too small".

We had to drive back to change the resolution back to 800x600 as they were unable to do that themselves. It was naturally my own fault that we had to do so, since I was unaware that that might cause any problems.

When the users are generally not very knowledgeable about computers, they most likely don't know the dangers of viruses. We usually transferred data between our computers and the districts' computers by USB-drives. We had some problems with some annoying viruses in the first month which came from the computer of our Hue-employee. It was an executable that looked like a folder in Windows and it shared the name of the parent folder. When clicked on, it installed an application that made the computer reboot when it recognized certain strings. It was not a harmful virus, but very annoying.

We thought we encountered the same virus at the revisit to the TP Hue district 27th of October. I noticed the virus coming on USB-drive, but I assumed it was the same harmless virus that didn't do anything before it was actually clicked.

On the USB-drive it proceeded to destroy all the folders, including all the installation files we were to use that day, and it had an executable named copy.exe that immediately ran when I inserted the USB-drive in my computer. My computer got infected and it rebooted. The virus corrupted my winlogon so that my machine always rebooted within 10 seconds of logging on. I managed to make a new administrator account in the 10 seconds-window I had before it rebooted. This enabled me to scan the computer and remove the virus. For this installation the Norwegian student that was stationed in HCMC had come up to Hue. He uses a Mac, and with that he was able to remove all viruses from the USB-drive and also retrieve that data we needed for the installation. Without a Mac I don't think that would have been possible.

We made a decision to get the best free anti-virus program that existed and install it on all computers at the districts. We got AVG (AVG 2007) as it's highly recommended and the best free anti-virus available. It went very slow at the districts, but we did manage to remove a lot of viruses (there were viruses at all districts), but since they have no internet they are unable to update AVG easily. We're not really sure that the users know the dangers of viruses or actually know what viruses are even though we tried to explain it to them.

Language barriers

None of the workers at the districts could speak English. Only the employee at TP Hue was able to understand some English, but not nearly enough to make a difference, so we had to rely on an interpreter. The HISP employee in Hue has decent knowledge of English, but even between us it was very hard to understand at times, especially when the conversations turned technical and detailed. It was hard for her to get her points across when discussing specific details on things us Norwegians didn't have thorough knowledge about, like how the current reporting system in Thua Thien-Hue worked compared to how the users wanted DHIS 2 to work.

We were relying on our employee to give messages to the users, and that she was able to give us the correct feedback from the users. Most of the time it seemed to work fine, but we could never be certain that all the feedback from the users was returned to us when they were talking, and even arguing, in Vietnamese for lengthy periods of time without mentioning much to us. By looking at the feedback we received I think we got most of it covered.

Problems with the software itself or the computers

Usually the software worked fine at the districts, but there were exceptions. We were unable to import or export data for the most part. This wasn't fixed until late November when we were going home. This meant that if we had data that needed to be imported or

exported somewhere we had to take them to the office and do workarounds until it worked, and then go back to the district with the new version afterwards. This was mostly a problem at Huong Thuy around the times the database structure was changed.

DHIS 2 was designed for resolutions at 1024x768 or above. All districts used 800x600, but this was only a problem at those districts that had the most wards as the organization unit tree would expand out of sight. The monitor at Huong Tra failed when we tried 1024x768, and the users at Huong Thuy were unable to see anything at that resolution.

For some reason, the software didn't work as expected in the districts. After putting a new package together for Huong Thuy, tested on both two different laptops, the software crashed at the district. We received some errors there with the generation of min/max values that we didn't get on our computers. The software would not generate values when we asked it to. It started working after we had generated a custom value, but then it would not show the correct minimum value. Even though this isn't a critical failure, it's unfortunate to find errors when you are out in the field.

We went to both Huong Thuy and Phu Loc at 19th of October, and with the same installation package we encountered differences. At Huong Thuy we were unable to make a new user, while at Phu Loc it worked perfectly like it did when we tested it beforehand. At Huong Thuy we got an error which said we had to "Please specify raw password" when making a new user, and this is a problem we never understood why we got.

At TP Hue we had to do workarounds because even though the Windows account was set as an administrator account, it did not have administrator privileges. This provided some problems as the way we change databases with PostgreSQL requires administrative privileges. This was later fixed when they reinstalled Windows at that district.

The lack of a proper user manual

When we first arrived we had no user manual in Vietnamese. For the first couple of visits we wrote down instructions on simple text files for the users to read if they had problems. It was very basic and just explained them the flow of the program. The employee in Hue later customized the HCMC user manual for the users in Hue, but that was something that we should have had from the beginning.

Users interpret bugs in the software wrongly

We had a bug in the min/max value generation that left a field red after data was entered. At Huong Thuy this error made the user stop entering data between two visits as they only knew that red was a sign of trouble, and green was safe. They thought the values weren't saved if a field was red, so they just stopped instead of actually testing that it was saved or not, for example by making reports. This is severe and it just makes a point that having a stable and bug free release is crucial.

Feeling of having to baby-sit the users

The combination of unknowledgeable users and infrequent visits is unfortunate. There are important tasks that the users need to be able to perform on their own, and that they need to understand why they are doing it, but most of the time I felt that it went in one ear and out the other.

Before we came to Hue the common method of taking database backup was to copy the whole PostgreSQL folder instead of for example using administrative tools (for example PGAdmin) to make proper backups of the database. We made a little script to take backups, but I'm not sure if it was used. Admittedly, there was no data entering between a few of our visits so that a backup wouldn't need to be taken, but it was reckoned as being important for the future.

Backups are especially important in an unstable environment. The hardware can't really be trusted and the computers are also infested with virus. I got reports that the systems at two districts had broken down after we returned to Norway.

The users don't adapt

The Vietnamese are bound by tradition and they have problems adapting to new approaches. At the time of this writing Phu Loc aren't exporting reports B6, B8 and B14 because they are waiting for customized data entry so that the data entry looks exactly like how their paper reports are. They want a new module just because they have to input data vertically instead of horizontally. It would be easier for them if they had a customized data entry naturally, but they could at least try to get used to entering it and getting used to it.

Huge amounts of data to be reported

The workers may feel that this is an extra burden on them since entering data is a very time consuming task. They also have other tasks to do, and when they are asked to enter data for several months for several reports the task might seem contradictory to what it's supposed to do, easing their workload on reports.

Transportation

The times when we could not go to the districts for whatever reasons we would have liked the possibility of public transportation of some sort. However, there was no reliable transportation of this kind available. Using taxis would be too expensive in the long run, and the other option would be driving to the districts ourselves. It's easy to rent a motorbike, but none of us knew how to drive it and there could also be some legal issues as we heard reports about foreigners being stopped if they were seen driving.

Electronic sending of reports

Ideally you would want to send reports every month electronically for efficiency. The infrastructure in Hue does not allow this as only one of the four districts, TP Hue, had access to the internet.

8.2 The implementation plan

We tried our best to follow the plan that was made for us in the beginning of August when we first arrived in Hue (Appendix A). Some parts of it weren't complete, while others actually were a bit ahead of schedule. The plan followed the same approach as earlier implementations, with pilot districts and scaling after a set time. The pilot district chosen was the city district of Hue. The new Hue-report tool (ref. 7.1.4) was set to have initially one report, and scale together with the implementation efforts to all 15 reports by the end of the year.

The testing and prototyping phase in Hue district went fine, except that we did not have any pivot tables ready. We didn't see it as very dramatic as there was no working import/export at the time, a problem that was solved just as we left the country.

I think we followed the plan in phase one quite nicely. We may have had fewer visits than what was originally planned, but that was mostly because we all agreed that there was no need for it as the pilot in TP Hue went very smoothly.

Phase two started in the beginning of September and the software was installed as described earlier. We did not have a training seminar for all four offices as we didn't see the need for it. Braa et al. (2004) also say that training in focused on individual trainers on-site within facilities is effective to stimulate individual users, and to gradually develop some super-users, but it can be a problematic approach when it needs to scale up. Thua Thien-Hue only has nine districts, and there's only so much scaling that can be done within this province. We rendered a training seminar as unnecessary when we only had four districts and four persons entering data to work with.

Bug fixes based on feedback were mostly fixed rather easily if there weren't anything major. At the end of the stay we also had most of the reports ready for data entry for the users.

8.3 Aside from all the issues

Even though I raised a lot of issues that was encountered during the implementation, there weren't always problems.

The software

For the most part the software worked satisfactorily. Overall the software is good and will in the long run ease the workload on the users at the districts. Most of the users at all

the districts were happy with the software and most seemed to understand that it was work in process so a few bugs was acceptable. They seemed to share, and understand, our frustration when unexpected issues arised. They had previously used DHIS 1.4 and all the users pointed out that it was a huge step in the right direction, especially in terms of user friendliness.

We mainly focused on data entry and to generate reports. They are fairly trivial tasks, and there were usually no problems with it as long as the hardware was up for it. The Hue report tool was of course a great addition to the software as it was specialized for the users in Hue and it replaces the need for paper reports. All districts should have working printers so even though the infrastructure isn't on the stage where they can send reports electronically they can still use the software, print out the reports and send them to the province.

The users

All the users seemed rather positive as far as I'm concerned. We felt welcome at any district, and it didn't seem like they thought us or the software as an extra burden. We had been warned that it could be difficult for us as foreigners to be trusted, but there didn't seem to be any problems. This was possibly because they were used to foreigners from previous implementations.

8.4 Status in Hue when we left

We had installed in four districts when we left, but as there were no working import/export at the time none of the districts actively exported their data to the province. All the computers were working, but only three were entering data because of the course the employee at Hue was taking.

When we left Vietnam the report module had been finalized and all 15 reports were looking exactly like their paper counterparts, but the data entry differed on reports B6, B8 and B14 compared to how they filled in the reports on paper.

8.4.1 Current status of the project in Hue

Based on reports from the HISP-employee in Hue the project is as of April 2007 behind schedule. They are still suffering from problems. The computers at both Huong Tra and TP Hue broke down in February. Last reports were that the computer at TP Hue is still not fixed, and that it's issues with the hard drive. The computer at Huong Tra has been fixed, however both districts are not able to enter data because of the employees there. The employee at the TP Hue is reportedly still doing her course (which I thought was over in November), and therefore they have none to enter data as well as a non-functional computer. The employee at the Huong Tra-district has been on a business trip to HCMC for several weeks so DHIS 2 has yet not been reinstalled there after the hardware breakdown.

Phu Loc and Huong Thuy have stable versions of M6 running with exports of reports to the provincial office regularly. They are not exporting B6, B8 and B14 and by the sounds it they refuse to do so until the data entry becomes customizable.

In agreement with the HISP-coordinator in Vietnam they've not scaled up the implementation according to the plan.

8.5 The third implementation in Ho Chi Minh City

Ho Chi Minh City is Vietnam's largest city with a population of over six million people. DHIS 2 with the mother and child health program has been installed in 24 districts and 6 hospitals in HCMC. They are also planning to implement DHIS 2 at the ward level in a few districts.

HCMC seem to have a better infrastructure and facilities overall than Hue. Most computers are relatively new, though not very powerful. District 5 has its own server and they intend to install DHIS 2 on it as a web application so all wards can connect and enter data via that server. If a district has insufficient hardware, the district will pay for upgrades.

HCMC use milestone releases and not trunk. The mother program has been using M5, and the child program is using M6. The mother program has changed their reports for 2007, so they will all need to be updated, but they have no plans at the moment to update the child program to any newer milestones.

When it comes to the users they've also got a varied response to the system. Some users see it as beneficial that the system is helping them with reports, whereas most don't like it. They use it superficially or after the HCMC-team have given them a warning for not turning in the reports for the last month. Every district has to send in their reports on the 10th every month with no exceptions.

There doesn't seem to be any problems with computer security, or at least the HCMC-team doesn't need to worry about it. Most districts have their own computer staff that fixes any problems that may occur.

The users at HCMC also seem to be a bit better when it comes to computer skills. It's estimated that 1/3 only has basic computer knowledge, whereas the rest don't really have any problems.

Since HCMC is urban there shouldn't be many problems going to the different hospitals even the city spreads over a large area. The Vietnamese team all owns their own motorbikes that they use, or apart from that they use the bus.

"We don't have any problems getting around. We use our motorbikes if the distance is less than 30 minutes on the bike. Some organization units are further away, to reach them we travel by bus". - HISP employee in HCMC.

The implementation was done prior to implementation in Hue. It started in April, but the complete rollout in all districts was mostly done over a two week period in August 2006. The implementation was lead and done by the Vietnamese team.

Currently their number one problem is wrong data. There isn't much internal validation of data, they just enter the data they get. Fortunately, this problem should be gone after the data entry validation module is in place.

"Most of the problems we have relate to wrong data inputs. The employees at the ward level fill in wrong number in total fields and send the paper reports to district. The users on the district level just enter all the numbers they get from the wards without checking them". - HISP employee in HCMC.

9. User Training

Our Vietnamese HISP employee had to be in charge of the user training most of the time because of the language barrier. In this section I will give my thoughts on how I felt the training of the users went and the methods that were most commonly used.

9.1 Methods of training

We didn't use many methods for performing the training, as it was limited what we had time to at the districts at every visit, but the following paragraphs describes what we focused on and what limitations there were.

9.1.1 Goals of the user training

The primary goal was naturally to teach the users how to use the software from scratch where they start the software, to navigating between the different modules, to specific tasks like entering data and generating or saving reports.

We did not have much focus on affective outcomes (ref. 2.4.2) as they had all used DHIS 1.4 before so they should have known the usefulness of the system.

9.1.2 Learning by doing

I'm a strong believer in learning by doing with supervision. I feel that the best way of learning is by doing tasks with the target system by yourself instead of watching someone else do it or by reading about it. Our Vietnamese HISP-employee in Hue was a bit too keen on taking control by working with the program herself and telling the user what to do instead of letting the user do it herself. We emphasized that the user had to learn to do it on her own. This way we forced the users to start from scratch by opening the software, filling out reports based on their own paper reports they had received from the wards. By making the users do all the tasks that were required for them to use the software successfully we hoped that they would have no problem using it when we weren't there supervising.

I felt however that we had limited time at the districts to perform proper training, and that the users weren't always too interested to repeat the same tasks over and over again so that we could be sure that they understood it. The lack of a proper user manual (ref. 8.2) emphasized the need on good initial training.

9.1.3 Observation

As observation techniques we used both user-observation and instructor-observation. We observed the user closely and we corrected mistakes as the user was doing them. Close observation was needed as if the users are not very careful with the data they enter (which

in some cases it didn't seem like (ref. 8.5)), the data will be wrong and in worst case it may lead to wrong decisions being taken at a higher level based on the data entered. We also made the user watch the instructor perform tasks in the software and later practicing what had been done.

9.1.4 Limitations and methods not used

There were some methods of learning or user training that we did not apply. E-learning was naturally out of the questions due to the limited technical infrastructure and that we needed to have heavy focus on personal interaction with the users with on-site training and technical support.

Another method that could have been used was group-oriented learning where users get together and learn together. It was planned to have a one day seminar for the users at all districts (ref. 8.2), but we decided not to. In hindsight it could have given all the users another way of learning about the software.

9.2 Common mistakes

The most common mistake of all was probably that the users didn't understand the difference between entering nothing and entering 0 in the system. Every user made that mistake, but after some explanation from our Vietnamese employee they all understood the importance between reporting 0 and having nothing to report.

One bug wasn't caught in the software before we incidentally noticed some very large numbers for some data elements. The users wanted early on to use Enter as a key to jump to the next field in the data entry as opposed to using Tab. Enter was the key they were used to from DHIS 1.4. We fixed that, however by pressing Enter in the last field in the Data Entry you jumped back to the first field. This would have caused major errors in the database if we hadn't noticed what the users did when entering data. On a lot of reports they had mostly 0-values for most data elements. This meant that to enter data as quickly and efficiently as possible they pressed 0 and enter rapidly in succession. The hardware and/or software couldn't process the input faster than they entered, which meant that when they saw that they had reached the bottom of the report they had in fact added a 0 to values in the beginning of report. One data element at Huong Thuy therefore had a value of 2090 instead of 209 for one month.

9.3 Efficiency

As it is a time consuming task to enter data for the workers we tried to teach them how to be efficient. An easy way of doing it was to teach them how to use the numpad instead of the normal keyboard for entering data. None of the workers used numpad by default. Quite a bit of time can be saved by changing simple procedures like that, especially when the workload at the districts are as they were (ref. 8.1).

9.4 Intuitiveness

We had to be careful in guiding the user through the software. A simple and intuitive task for computer experts might not be as simple for someone with only basic computer skills. An example was that in Phu Loc, the employee could not understand how she was supposed to choose a different report in Data Entry as she did not understand how a dropdown-list worked.

9.5 Language barrier

The language barrier made it immensely more difficult to perform user training by myself. I had to rely on our Vietnamese employee, but we didn't always see or think the same things. Usually discussions could turn quite technical and we both had problems understanding each other.

From my past as a part-time support for programming students I found the best way to perform user training was to sit beside them, let them do everything while explaining it in detail. This was an option not available to me in Vietnam.

9.6 Summary of user training

What follows is a highly subjective table of how I perceived the users, their reactions to the system when we were visiting the districts. The ratings I've chosen is poor, mediocre and good which I think speak for itself. I added a column called potential super-users. Every district had one employee that were in charge of entering data (ref. table 1), and any potential super-users would naturally be one of them. A super-user is a person with unlimited access privileges who can perform any and all operations on the computer or software. With local capacity building and aiming for both scaling up the project and accomplish sustainability by gradually developing a super-user is important.

District	Computer Skill	Sufficient Training	Potential super-user	User Satisfaction
Huong Thuy	Poor	Yes	No	Good
Huong Tra	Poor	Yes	No	Mediocre
Phu Loc	Poor	Yes	No	Good
Hue City	Mediocre	Yes	No	Good

Table 3: Summary of user training

10. User-developer Links

In this chapter I'll look more into the link between the users and the developers in the HISP Vietnam-project. I've chosen to limit this as much as possible to Vietnam as that's more relevant for my thesis.

10.1 My role in the HISP Vietnam project

One of my roles in the HISP Vietnam project was a link between the developers and the users, in other words a facilitator or an implementer. I brought the software to the users and the feedback from the users back to the developers. HISP is a global software project, but the core developers reside in Oslo, so it's important that the users have someone that can communicate with the team in Oslo.

10.2 Users and developers

Who are the users and who are the developers? I see a developer as someone that is working with improvements of the software in any way, and I see a user as someone that uses the end product in a live setting. Thinking this there are people that are both users and developers. The whole Vietnamese team can be seen as being both, whereas the developers in Norway are only developers.

Our HISP employee in Hue, who can be seen as both a developer and a user, wasn't a person that would do programming tasks for bug fixes, but mostly worked on the reporting tool, the database or with the users. So many tasks that required programming not directly related to the Vietnamese installation (e.g. the report tool) was reported to Oslo or to HCMC. The users in Hue have no contact with those developers, and a link, a facilitator, emerged as me that had to bring the developers or the coordinators the feedback from the implementation.

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This means that the developers aren't directly in touch with the user base. It is not something that's unique for Hue, but whether or not this really is an issue can be discussed. The DHIS 2 has been developed based on the requirements from DHIS 1 (ref 3.2) which has been in use for many years.

With implementations in new areas the software might not support local requirements. Issues will arise and there will be a need for communication between the users that have the feedback and the knowledge about how they need the software to work and the developers that are required to fulfill the needs of the users. Local capacity building with local developers would in some cases delete the link from the facilitator to the developers in Oslo as seen in HCMC where HISP has employed three developers that works with both users and customizing the software to meet local demands.

10.3 Feedback from the users

Being the link between two parties isn't always a pleasing task. Usually it meant bringing more work to already pressured developers when something malfunctioned or when new requirements were discovered. We were also to blame if the users were unhappy with anything in the software as we were the only link to the users.

We used various methods of presenting the feedback to the developers. It depended on the complexity, urgency and severity of the task. If it was a simple bug fix that was needed we usually just mentioned it to the developers in HCMC or we sorted it ourselves, and we usually had it done before the next installation. An example can be when the users wanted to use Enter instead of Tab to jump to the next field in the data entry as they were used to from DHIS 1.4. This was something easy enough for one person to do in a relative short period of time.

We also had a lot of positive feedback and thoughts of our own not directly related to the software that we wanted Oslo, or anyone else for that matter, to be able to read. We made a wiki-page where we had weekly reports from Hue where this was posted. I'm not sure how many people that actually was aware of the wiki-page at the time. At least one core developer asked me about the progress in Hue at the end of our stay there, without knowing we had such a wiki-page, so it should have been advertised a bit more.

We also received feedback that would require some work. This was usually taken to the mailing list where the most urgent matters are discussed. Unfortunately, it seemed as if the more complex a request from a user was the less chance was it that the developers would do anything about it.

A typical example was the sorting of the organization unit tree when we were at the TP Hue district. It was a long discussion on the mailing list which ended up in a concrete task that was up for grabs, but none was interested in doing it so it all ended in nothing.

There are of course many reasons for why a request from a user or a facilitator won't be fulfilled. All core developers are volunteers and they have already enough work on their hands so they can't do everything everyone asks for. The same goes for the project coordinators. It's still the users that suffer because of the scarce resources.

10.4 The contact between Oslo and Vietnam

In this section I will take a look at the communication between the developers (Oslo) and the facilitators (Vietnam) over a period of time. Even though many in Vietnam can be classified as developers, I feel that all the communication between Vietnam and Oslo can be related to the end-users in some way or another.

I will look at data from the main sources of communication in the project the mailing list and the wiki.

10.4.1 Limitations

There are a lot of informal private conversations that an analysis won't cover. Communications through private e-mail and instant messaging (ref. 4.3.3) usually won't be broadcasted unless it's a predetermined meeting. However, issues that are important tend to get posted on the wiki or the mailing list.

Time is also a limiting factor. My goal is to provide analysis over the last year, so the whole duration of all the implementation efforts is not included. Many things can change over the course of a year, especially as Norwegian students that can have an impact of the degree of activity arrive in Vietnam.

10.4.2 The wiki

The wiki in relation to Vietnam is mainly used for status reports on the situation. It's mostly a one-way communication between Vietnam and the rest of HISP. The Vietnamese developers and the Norwegian Hue team had their own personal space on the HISP-wiki that they were meant to update every week with current assignments, status on those assignments, problems and suggestions. This way anyone interested can follow the progress.

The Status reports

A Norwegian student doing fieldwork in Vietnam in early 2006 decided it was a good idea that every Vietnamese developer had their own page where it was possible to track their current assignments and progress. In May 2006 the developers started updating their page regularly. What follows is a summary of their activity on the wiki and the activity during the time of the Norwegian fieldwork which lasted for 14 weeks excluding three weeks of holidays.

Developer 1: Skipped four weeks in 2006, and has already skipped four weeks in 2007 (by doing reports for several weeks at the time). The status reports are very scarce and sometimes only consist of just current assignments with no updates on status or problems/issues. Timeframe and other thoughts or suggestions has only been filled out a few times total. This developer filled in reports every week during the stay of the Norwegians.

Developer 2: Started reporting in week 16 of 2006 and skipped a total of 11 weeks until no reports were filled out after week 49. Problems/Issues, timeframes and other suggestions were filled out very infrequently. Four of the weeks skipped was during the Norwegian fieldwork, and three of them was during the vacation of the Norwegian students.

Developer 3: Started reporting in week 16 and skipped a total of five weeks. The developer stopped reporting after week 1 in 2007. Same as above when it came to the

other points that weren't updated often. This developer did not skip any reports during the time of the Norwegian fieldwork.

Developer 4: Skipped six weeks in 2006. This developer stopped reporting after filling out five weeks in 2007. Rarely updated anything else than status and current assignments. Filled in status reports every week during the Norwegian fieldwork except for two weeks when the Norwegians were on holiday.

The implementation page

The other main Vietnam-related wiki page is the implementation pages that shows the date and status of all districts where DHIS 2 has been installed in. However, after updating that a new installation has taken place in a new district it is usually never updated again. The recent actions from both Hue and HCMC were last updated the summer of 2006.

About the use of the wiki

It's a tool that is not fully utilized. The lack of updates and information in the updates can be caused by a number of things. It can be lack of feedback, if they are required to update just for the sake of updating then they might not see the value of doing so. It's not either an "official" approach as its idea is derived from a Norwegian student.

10.4.3 The mailing list

The mailing list is used for two-way communications between Vietnam and the rest of the HISP-nodes; however most of the communication related to Vietnam is between Oslo and Vietnam. I've gone through all the mails that are related to Vietnam from May 2005 to March 2006 to see the impact on Norwegian students and their fieldwork in Vietnam, and if there has been an impact, what happens when the Norwegians leave Vietnam.

The methods for the analysis

I categorized the sender of the mails into five different groups based on who sent them:

- Mails from Vietnamese (any Vietnamese developer or facilitator).
- Mails from Norwegians in Vietnam, which were students doing fieldwork in Vietnam.
- Mails from Norwegian developers or coordinators, which is mostly core developers, but also other Norwegians working on any aspects of HISP as well as the Norwegian students when they were not in Vietnam.
- Mails from other HISP nodes. This is mails from any other nodes in the HISP-project, for instance India.
- Mails that were not in relation to the HISP-Vietnam project sent by Vietnamese.

I also categorized the mails into four different types of mails.

- Support. Typically questions about something that goes wrong when trying to run the software.
- Technical. This is typically discussions between developers about how to solve programming issues.
- Administrative. This includes mails that are about updates to wiki, where to download the newest milestone, documentation etc.
- Requirements. This was discussions about what the software needed to do for Vietnam.

All mails are categorized by month as that's a fairly easy and defining time limit to work with.

Mails sent per month per group

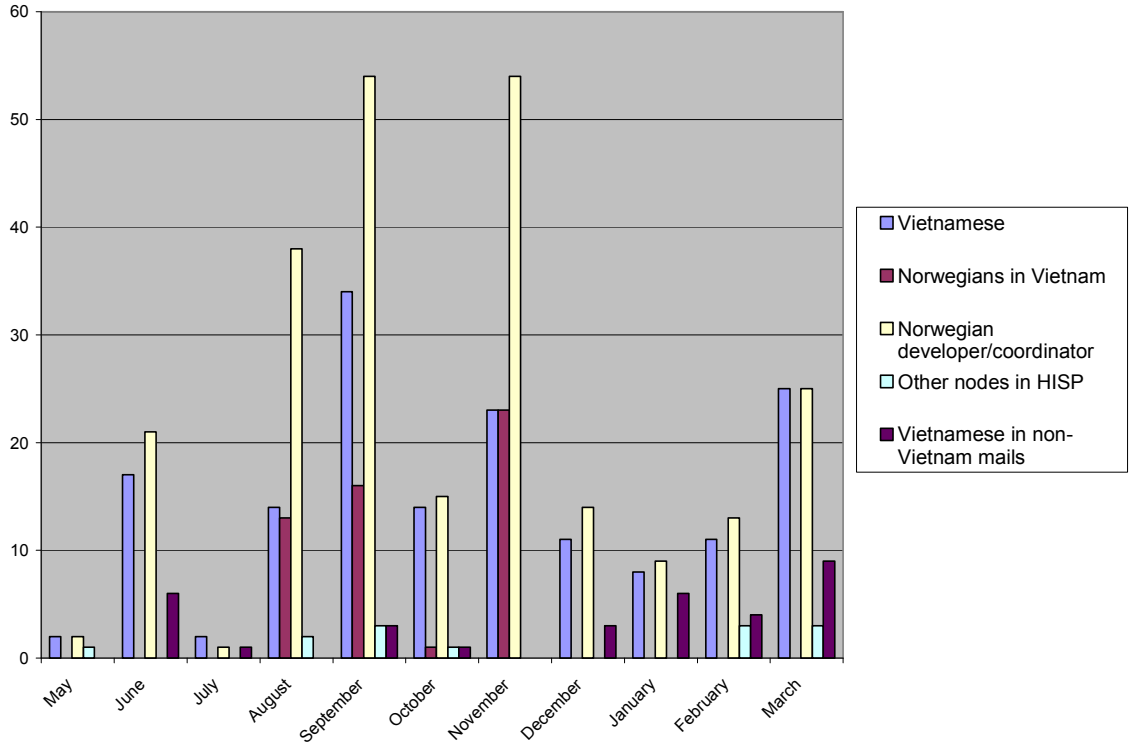

Figure 8: Mails sent per month per group.

This table shows that there was a huge increase in the number of mails related to HISP-Vietnam sent in August, September and November. It is very interesting to see the lack of mails being sent in October which was when the Norwegians in Vietnam went on a three week vacation. In October both mails from Vietnamese and especially mails from developers and coordinators in Norway diminished. After the Norwegians left in November the number of mails sent decreased from all parties over the next few months.

When the Norwegians were in Vietnam we can see that they didn't send all that many mails compared to the Vietnamese. So the increase in activity in communication definitely didn't just come from the Norwegians.

Total mails sent in relation to HISP Vietnam

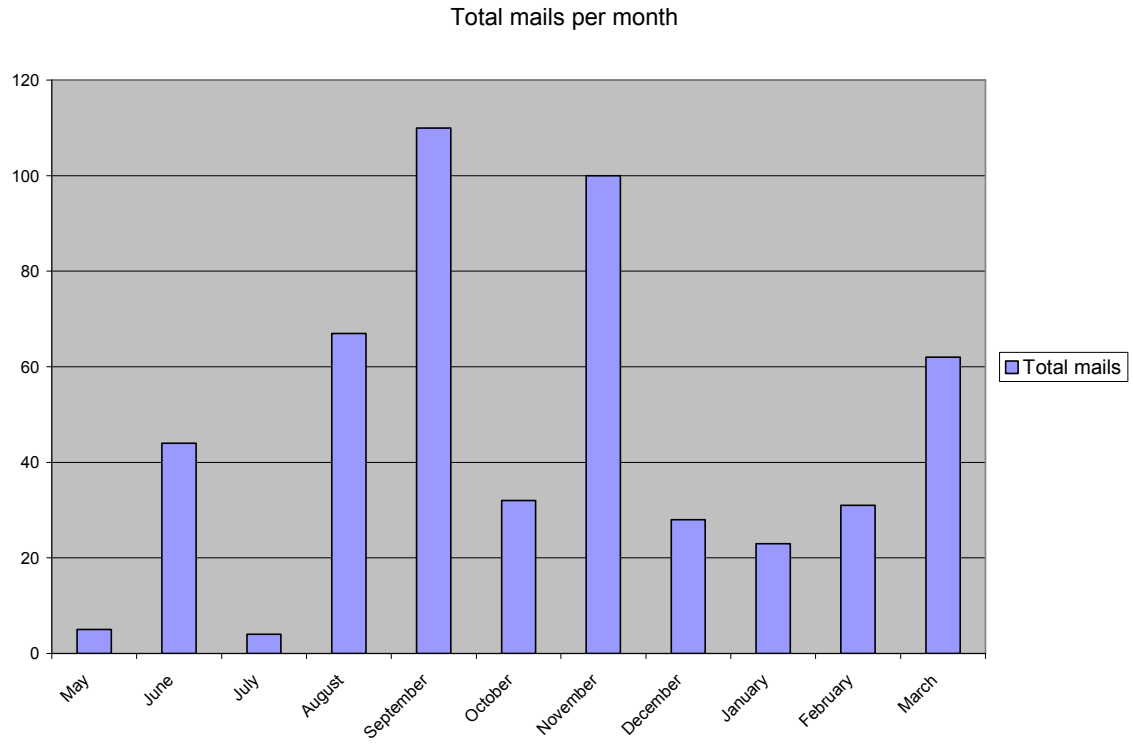

Figure 9: Total mails sent by month.

This is the same graph as the one over where all groups have been turned into one. Again it's easy to see the activity being high during the three months the Norwegians were very active in Vietnam.

Contents of mails sent

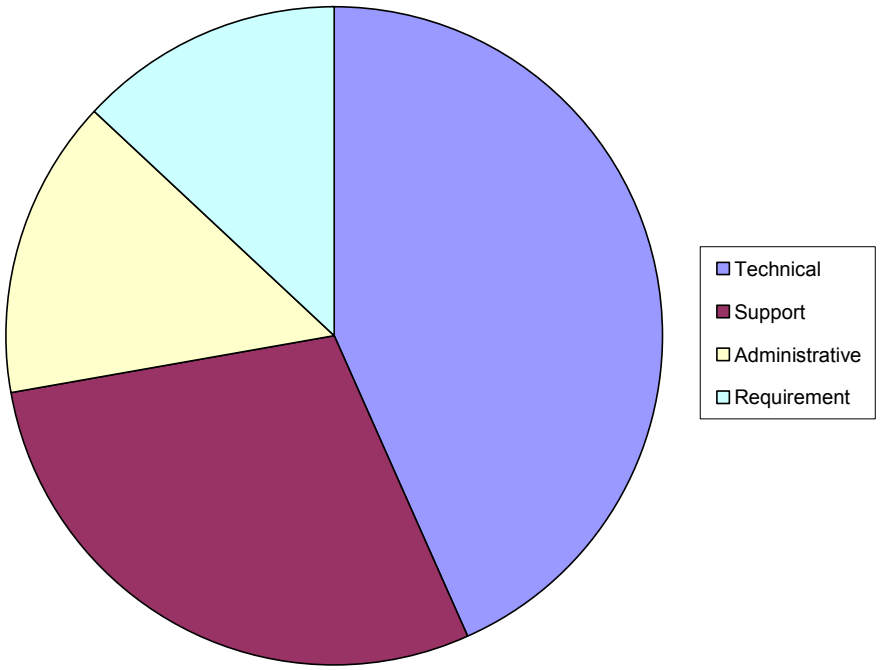

Figure 10: Contents of all mails sent

This graph shows which kinds of discussions were more frequent. Almost half of all mails featured technical discussions between developers or coordinators from both countries.

Threads started by Vietnamese per month

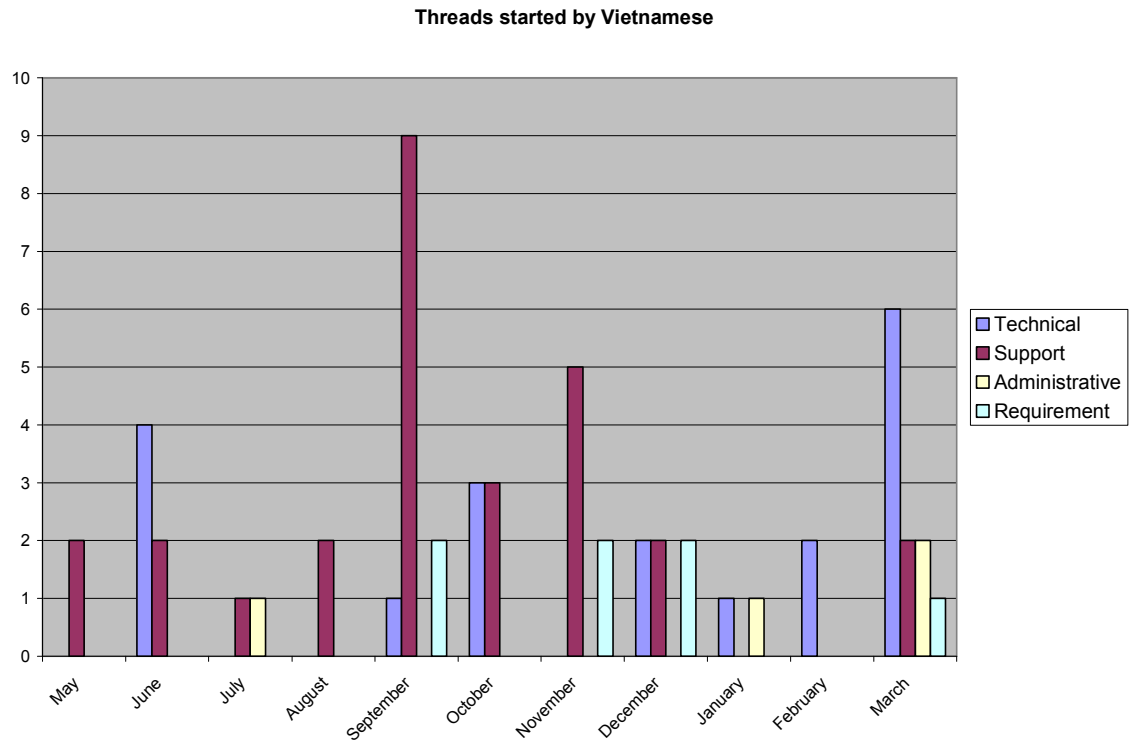

Figure 11: Threads started by Vietnamese grouped by contents and month

This graph shows all the threads that were started by the Vietnamese on the mailing list and what topics of the mails covered. As seen, most of the mails have been support mails where the Vietnamese typically asks for help about something that has gone wrong with the software. It's interesting to see the increase in technical in March, which also accounts for the increase in total mails in March compared to previous months seen in figure 9.

Contents of threads started

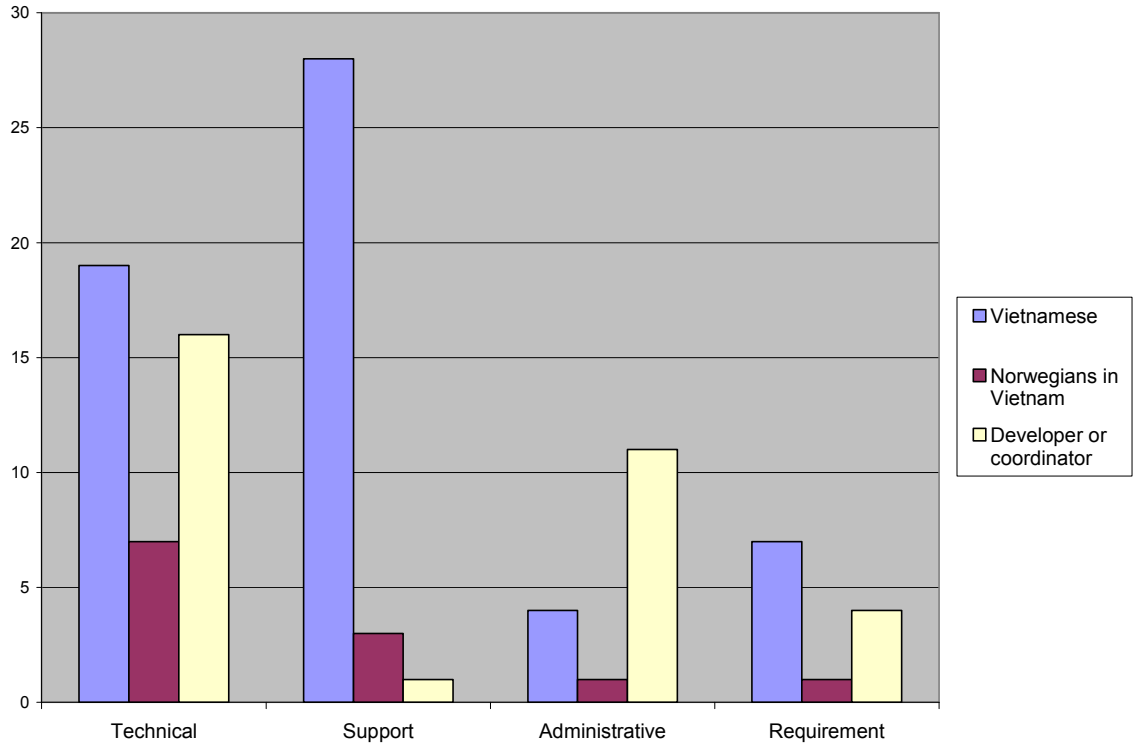

Figure 12: Threads started categorized by type of sender and contents

This graph shows a comparison of threads started by the specific groups and the contents of each thread. The majority of threads labelled support came from the Vietnamese, where as the developers and coordinators mostly started technical or administrative discussions in relation the HISP Vietnam project.

Activity from Hue

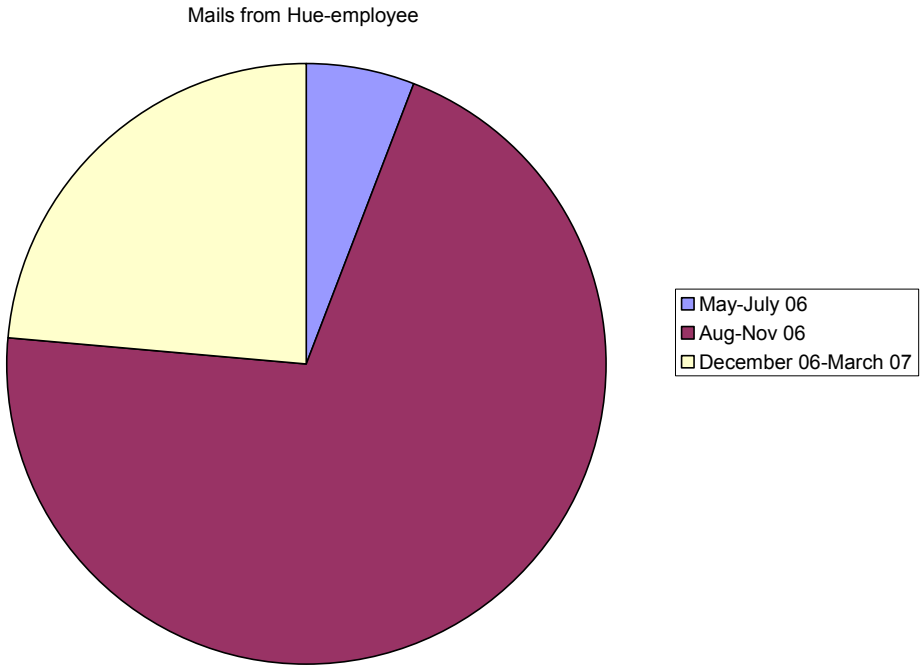

Figure 13: Mails sent from Hue-employee.

This is an overview over the activity from the Hue-employee on the mailing list three months prior to the Norwegians coming to Hue, during the period of our stay and for a period of four months after our departure. Roughly three fourths of the mails were sent during the period when the Norwegians were in Hue.

An overview over commits per month

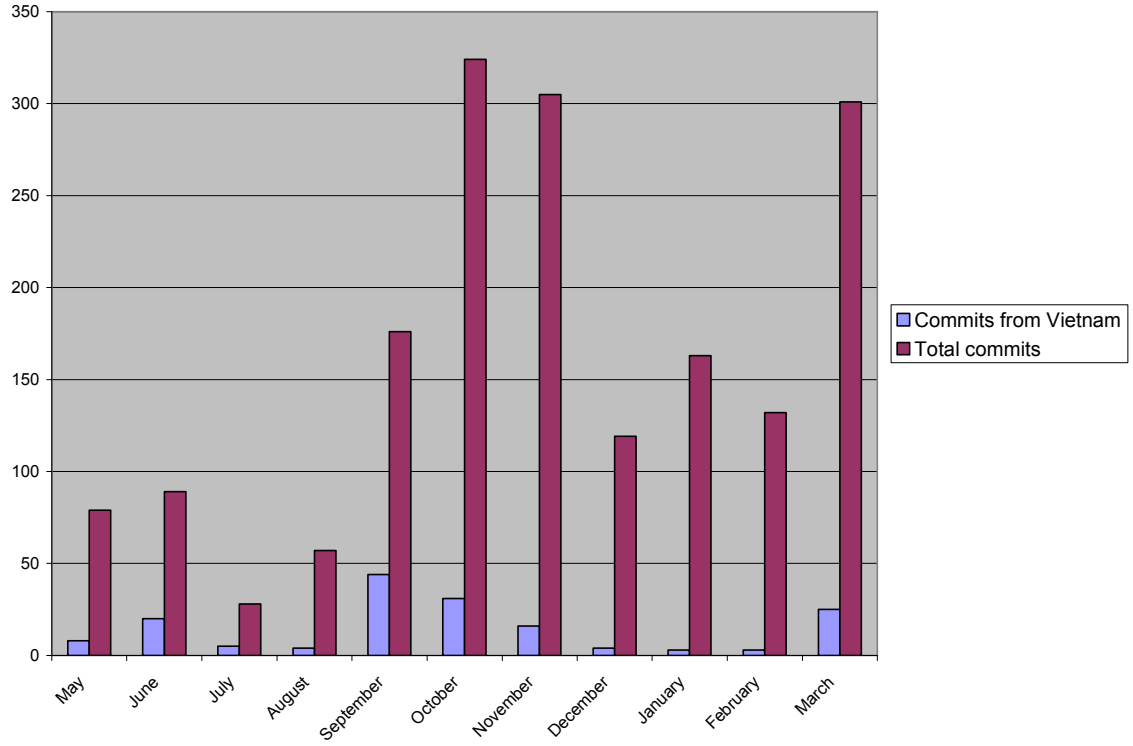

Figure 14: Comparison between Vietnamese commits and total commits

I decided to see if there was any difference also in activity on the programming aspects of the project. This graph shows the number of total commits that Vietnamese did in comparison to the total number of changes that other developers did to the repository.

Part 4: Discussion and conclusion

Chapters in this part include:

11 Discussion
12 Conclusion

This is the last part of the thesis and here I will discuss my research objectives based my empirical studies, methods and literature. The conclusion will summarize my findings.

11. Discussion

In this section I will review my research objectives and question and discuss my empirical studies in relation to the literature presented in chapter 2 and the concepts of chapter 4.

Primary research objective: *Join in on a team that wants to lay down the foundation of a successful implementation of DHIS 2 in a province in Vietnam.*

This can be argued to be a very broad objective, but nonetheless I will try to discuss this objective based on my studies in Vietnam, the ongoing implementation in HCMC and combine it with relevant literature like Braa et. al (2004A). I will also see if the implementation could have been handled differently and come with suggestions on how it can be improved as this is still an ongoing process.

Secondary research objective: *During the implementation process, I was a facilitator, a link between the users and the developers and I wanted to make sure the users got full support from HISP in regards to training, guidance and technical support, and to keep the developers and coordinators in Norway fully informed about the progress.*

This research objective will be discussed based on my experiences with the users and my role as a facilitator in Hue detailed in the empirical study, and I will draw comparisons with the HCMC implementation.

Research question: *What are the effects on the Vietnamese team when Norwegian master students arrive in Vietnam to work together with them, and how are the communication tools in HISP utilized?*

During the time in Vietnam I became part of a team of Vietnamese employees. I wanted to explore the effects of a Norwegian team being a part of the Vietnamese team working for the same cause. This will be discussed based on analysis' I've done.

This chapter will include the following sections:

- 11.1 - The foundation for a sustained system in Hue
- 11.2 - Users and the role as facilitator in Hue
- 11.3 - Norwegians in Vietnam and their effect on the HISP-Vietnam activity

11.1 The foundation for a sustained system in Hue

In this section I will focus on the first research objective.

11.1.1 Challenges facing the Hue-implementation

In 1978 at the WHO and UNICEF declared ”health for all” by the year of 2000 (ref. 2.3.2), and the best way to provide that was through a District Health System (ref. 2.3.3) which states that authority should be delegated to decentralised bodies.

I will analyze the situation Hue based on literature presented mainly from Braa et. al (2004A) where they question why so many attempts at implementing HISs in developing countries fail to persist over time. They presented two broad themes that needed to be addressed, sustainability and scalability (ref. 2.3.4) which I will look at in relation to the current efforts in Hue.

Local capacity building

In order to make the project successful over time there seems to be a need to increase the manpower of those working with the software. There have now been three Norwegian master students total in Hue to help with various implementations, and in previous implementations HISP has also been supported by a local software company and the local university.

Currently HISP has one employee in Hue that has a contract that finishes at the end of 2007, and the implementation efforts can’t be reliant on having students from Norway coming to support it. The employee has tried to recruit new students from the local university that she graduated from, but it proved to be difficult:

“The students don’t want to work with the project when they hear that they won’t get paid for it”.

At the time of this writing the project as I see it is still as being in the startup-phase. Not much progress has been made during the five months since I left the country. Even though two districts are reporting regularly, two districts are non-functional (ref 8.4.1).

Some of this can be contributed to the districts having only one person each being able to enter data (ref. 7.3.5). It is not enough when they have been as unreliable as they have proved to be. This will eventually lead to data being reported very inconsistently if it is entered at all. With users having huge amounts of data to be reported (ref. 8.1) there’s an increasing risk of data not being entered as time goes. This situation can be compared to the one from Mozambique where none at the MISAU had the technical skill to take over the vacant position after the developer had left (ref. 2.3.4). The goal must therefore be to double the amount of personnel that is capable of using the software to ensure that there are personnel available every month to enter the data required.

Another reason that can be contributed to the lack of progress is the lack of technical computer knowledge when computers have broken down. Computers remain unfixed for months (ref. 8.4.1), and they only have one computer at each district so there is no substitutes. The employee in Hue has no technical knowledge about fixing computers that have broken down, and the users mostly only have poor computers skills (ref. 9.6) so they are unable to fix it themselves. They are therefore reliant on external help, which to my understanding can be difficult to get in Hue.

Establishing local working routines

As of now there are no set routines for when a district is set to deliver the reports. Hue is fairly laid back with everything moving at slow pace. In HCMC the users are forced to deliver their reports within the 10th of every month (ref. 8.5) whether they like it or not. This kind of forced use of the system can prove very beneficial for the province once they receive data from all districts at the same time every month. However, based on my experience with the implementation detailed in chapters 7-9, the following prerequisites are needed to achieve persistent working routines.

- Appropriate hardware

When we first arrived two districts did not have sufficient hardware (ref. 7.3.5), one district was reported to have a non-working computer which in fact was not true, and two districts later have had hardware crashes (ref. 8.4.1). We also had problems with viruses at all districts (ref. 8.1).

- User support, guidance and follow-up

Even though the users received sufficient training, their computer skills were poor (ref. 9.6), and they did many errors (ref. 8.1 and 9.2-9.5). Between visits they did not always enter data although they promised to do so.

Our goal from the start was to have frequent visits to all districts to provide as good user support as we could and to monitor the progress at a close distance. This helped us pushing the users to use the software more often and possibly overcome some difficulties in using it on their behalf. Visits became infrequent due to circumstances that we couldn't prevent (ref. 8.1).

- Quick improvement of flaws according to local requirements and user wishes

Previous implementations in Vietnam have failed due to the lack of a working report module and hardware problems (ref. 6.2). The software needs to cater to the needs of the users, since DHIS 2 is meant to replace the old paper reporting system. This implies that it needs to work exactly like the system that it is supposed to replace. The report module (ref. 7.1.4) was created based on local requirements. As of now it is the backbone of DHIS in Vietnam, but there are still flaws in the software that will not eliminate the need

for the old reporting system until they are fixed. Three reports are not being exported in Hue (ref. 8.4.1) because the users don't want to enter data if it does not look like their paper reports. If the users refuse to use them, there is no other option than to accommodate their wishes.

Feedback was gathered continuously during our stay in Vietnam and we managed to improve a lot of minor issues to satisfy the users (ref. 10.3). Though, in general the users did not have a lot of input in regards to the system, so the user participation (ref. 2.4.1) was fairly limited when it came to contributions to how the software could be altered. After our departure there has been no mentions of additional improvement on the software from Hue except the wishes for an entire new module to accommodate the data entry problems in relation to the reports B6, B8 and B14 (ref. 8.4.1). The activity from Hue and Vietnam in general, has diminished (ref. 10.4.3) and the feedback gathered from users seems to have stopped.

Financial aspects

Even though the ICT in Vietnam is in rapid growth (ref. 5.5), there are substantial differences in the goal of the MoH and the actual number of computers available in the health sector (ref. 5.6). Thang (2004) say that finances are a reason for why there is limited access to ICT in Vietnam (ref. 2.2.1). In the province of Hue there was one computer at the districts we visited. The other districts in the province were lacking computers and in two contracts (ref. Appendix C and Appendix D) the health services had been responsible for supplying the remaining districts with computers, but that has not happened. The result was that HISP had to provide hardware (ref. 8.1) to districts with insufficient hardware. HISP also supports the running project implementation with a monthly contribution of 1.500.000 VND ($93) which covers the cost of transportation to and from the districts. In essence, there are no local funds to support the ongoing implementation so the implementation is highly dependant of HISP's contribution.

Scaling

Previous agreements (Appendix C and D) have emphasized on the need to expand to all the nine districts after the initial pilot phase. It has been the goals of all three implementations so far to in time include all nine districts. The first implementation in Hue only saw two pilot districts having the software installed (ref. 7.2.2). The next implementation was scaled to a total of five of the nine districts (ref. 7.2.3), and the ongoing implementation have stopped at four districts (ref. 7.4). The plan for the ongoing implementation was to scale up to seven districts by April 2007 and to all nine districts by July 2007 (ref. Appendix D). The Vietnamese coordinator for HISP has agreed with the health service to postpone the scaling. I've not received any information as to when the scaling will take place, but it's fair to assume it might happen when everything is working smoothly at the four districts that are currently using the software.

The importance of scaling has been stressed by Braa et. al (2004A) that state that scalability is a prerequisite and not a luxury for sustainability (ref. 2.3.4) and Braa et. al

(2004B) say that the system will only become relevant to managers when it's spread throughout whole areas (ref. 2.3.4), which means that it should be in the health service's interest that the software is successfully implemented in all nine district. Numbers from one district might not be very interesting in itself, but when those numbers are compared to all other districts' numbers they are. The goal should be, and as seen by all previous agreements, to scale to all nine districts in the province.

There are multiple problems concerned with scaling in Thua Thien-Hue province. The geography of the province combined with poor infrastructure (ref. 7.1.1) makes travelling to the districts furthest away from the city of Hue very difficult and time consuming. We already had problems when we were in Hue to register transport when we wanted to visit a total of four districts (ref. 8.1), so to register transport at the health service for regular visits for an additional five districts that are both more expensive and a more time-consuming to get to seems unlikely.

The biggest obstacle seems to be financial resources. In our agreement for the third implementation (ref. Appendix D) the district of Nam Dong was included as one of the five pilot districts. HISP had a responsibility to provide a computer for Nam Dong. We never went, or bought a computer, to Nam Dong, and the last four districts would be in the same situation. They all need computers that the health service had a responsibility to provide (Appendix D), but I don't see them having the resources or willingness to provide for that. The end result is that the districts furthest away from the province capital seem to miss out on the computerized HIS for the time being which is also stated to be one of the main challenges of ICT in developing world (ref. 2.2.1).

The implementation process

In hindsight I think that phase one which lasted from our arrival in August to mid-September (Appendix A) was bit too long. I think we could have accomplished more in total if we started phase two a bit earlier. Our initial pilot district became inactive after the pilot phase (ref. 8.1) so we didn't get to see any real progress over time in any of the districts we visited. Phase two went fine except for all the issues detailed earlier (8.1), and I believe it was correct to limit phase two to three additional districts excluding Nam Dong.

It's difficult to measure how successful the implementation efforts have been since it's still an ongoing process and it has not gone on for very long. According to Yetton et. al (1997) before the system is routinized the only measure of implementation success is usage (ref. 2.4). Beside the districts that have problems with their computers the current use of the software (ref. 8.4.1) seems satisfactory. They are reporting the data they can enter into the system monthly, and since the use of the system is voluntary it can be considered as successful (Abreu and Conrath, 1993). Talking about success may be a bit far-fetched still since only two of four, or nine, districts are reporting data regularly at the moment.

The sustainability of the HISP in Thua Thien-Hue

The third implementation efforts have proved that local success is possible in Hue (ref. 8.4.1) since Phu Loc and Huong Thuy are reporting data every month. However, this is not the same as the system achieving sustainability. It will have to overcome all the challenges discussed previously in this chapter. Braa et. al (2004) points at the system needing to work, in practice, over time (ref. 2.3.4) for it to be considered sustainable. The time frame that the third implementation has been in cannot be considered being "over time". Kimaro and Nhampossa (2005) say that adequate resources have to be allocated over a reasonable period of time to decrease the dependency on donors for sustainability to become possible.

Partly we are back to the problem of scalability in the Thua Thien-Hue province and the lack of financial resources. As it is now the implementation efforts are dependant on HISP which pays for the Hue employee who still is in charge of the implementation efforts. If her contract does not get renewed there will not be anyone left in Hue that has the knowledge to keep the implementation efforts going. She is also a valuable link, as she's the only link, between the donors, Oslo, and Hue. HISP also seem to pay for most of the hardware upgrades at the districts, and to remove the dependency of the donors, the health service will have to start doing that themselves.

As far as I'm concerned I don't see the health services having provided adequate resources. They have provided transportation (paid for by HISP), an office for the employee in Hue, and made sure the districts had a person allocated to capturing the data. This seems hardly enough to keep DHIS 2 going in the province over the long run.

11.1.2 The third implementation in HCMC

At this point it's natural to look at differences between the implementation of DHIS 2 in HCMC (ref. 8.5) and the Hue-implementation. There have been major differences between the implementations. The HCMC-team implemented in a much larger scale than what we did in Hue over a shorter period of time, and still they seem to have come out more successful than us in Hue.

- **Different versions of the software**

In HCMC they stuck to steady releases of the software whereas in Hue we worked from trunk. We didn't have much option at the time, and the decision to use trunk was a correct decision, but it did cause us problems (ref. 8.1). The bottom line is that the software was ready for a HCMC-release, while it wasn't ready for a Hue-release.

- **Differences in staffing and hardware**

They've seemed to have encountered fewer problems when it comes to the staff. In our initial pilot district in Hue no data was entered for months due to the employee being away, and this problem has amplified after I left Vietnam as currently there are two

districts in Hue suffering because of staff shortages (ref. 8.4.1). The employees in Hue had poor computer skill (ref. 9.6), whereas in HCMC they've seem to have a mixed bag of staff with good and poor skills (ref. 8.5). In both places the staff didn't seem too eager to enter data at all times. In Hue we also had to abort the first installation at Huong Tra due to hardware problems (ref. 8.1). In itself it wasn't that dramatic that we didn't complete the installation and the training on the 18th of October at Huong Tra. However, we weren't able to go back to the district for almost one month. This is naturally too much time between an unsuccessful installation and training and a revisit with new hardware.

The hardware in HCMC has seemed less prone to errors and if something malfunctioned they had technical staff at the site and resources to fix the problems themselves (ref. 8.5). In Hue they have no staff at all capable of fixing technical issues, and if something breaks down they have to wait for a third party to fix it. In Hue we also had massive problems with the viruses infecting the computers (ref. 8.1), where there haven't been such problems in HCMC.

According to Shaw et. al (2002) the most three important support factors are technical competence of support staff, staff response time and hardware and software downtime (ref. 2.4.3). In Hue we had no way to respond in time, and the hardware problems were appalling (ref. 8.1). HCMC didn't seem to have problems with either.

- **The installation in HCMC was done by the Vietnamese**

HISP employed three students from a local university from January 2006 to work from HCMC and do the implementation there. They have a lot better understanding than foreigners about the local context, and it's a lot easier for them to communicate with the users. An example can be that they had a support function in HCMC during their implementation efforts where the users could call if they needed help with something. In Hue technical problems or software-related problems were mostly up to the Norwegians to handle and because of the language barrier (ref. 8.1) such arrangements were impossible.

Another point was that foreign liaisons, the Norwegian students, played a major role in the Hue implementation. After they had gone the activity and technical knowledge about computers and the software decreased whereas in HCMC it has remained stable.

- **Differences in scaling**

It took three months from the first implementation in HCMC until they went ahead with a complete installation in all 24 districts and 6 hospitals. Seeing the whole of HCMC has it installed, the chances of it being sustainable increases compared to the Hue-implementation where there are problems related to scaling.

- **Transportation**

If something went wrong in HCMC they could respond quickly by travelling with their own motorbikes or going by bus (ref. 8.5). In Hue it was at times very difficult to arrange a car so we could go to a district. We always had to arrange the vehicle days in advance, and it was the only way of transportation we had (ref. 8.1).

- **Differences in reporting methods**

The users at the districts in HCMC are forced to deliver reports by the 10th of every month. This is something that we should have enforced in Hue, or at least something that should be arranged in future in Hue.

11.1.3 Summary of the foundation of a sustained system in Hue

In the following section I will summarize my findings in regards to the implementation in Hue. My analysis covered several challenges that need to be addressed in order to achieve sustainability (ref. 2.3.4) and to consider the implementation successful.

- Lack of local capacity

One person without sufficient technical skills about hardware and one employee at each district is not sufficient in the long run.

- Lack of appropriate hardware

The hardware is either prone to errors, too weak or in some districts non-existent.

- Local working routines must be set

There are no routines for when data is due to be delivered, and problems related to hardware and local capacity hinders data capturing.

- Lack of financial support

There does not seem to be money available from the local government.

- Difficulties in scaling

At the current time it's not possible to scale to all nine districts, which is necessary to obtain sustainability due to the problems mentioned above.

11.2 Users, user training and the role as a facilitator in Vietnam

In this section I will address my second research objective.

Expectations

I came down to Vietnam without being fully prepared for all the situations that could occur. I knew I would be perceived as an expert and that my main purpose was to help with the implementations, but I could not prepare myself for all the problems that were related to hardware, viruses or unexpected software errors. It was easy to sit in Norway and be an expert in running the system on our high-standard computers, but I had to quickly adapt to the Vietnamese situation as it turned out to be very different from what I was used to.

User training

Our main purpose with the training was skill based outcomes, which meant we focused on how to teach the users how to use the software (ref. 2.4.2). Unfortunately, we also had to spend time teaching users tasks that were not related to the software itself like performing virus scans (ref. 8.1). We conducted on-site training which meant we travelled to the districts and had sessions alone with the users in an environment that they felt comfortable with. This was also positive for us as we got a better understanding of how it the system was used by the end users in a real setting. The training had several limitations, one of them being time. Given unexpected software or hardware failures at the districts (ref. 8.1) we sometimes had to focus on fixing technical aspects instead of spending time conducting training. Time limitation was also one of the reasons why we didn't focus on affective outcomes (ref. 9.1.1). We knew all the users at the districts we had visited had used previous versions of the software previously so they should have already had that motivational knowledge (ref. 2.4.2). The limitations were quite unfortunate as it was quite clear from the beginning that the users themselves were not very knowledgeable about computers (ref. 9.6).

A typical session at the district was spent either learning the user to use the software (ref. 9.1.2) or watching the user closely (ref. 9.1.3). Observation (ref. 4.2.2) was more used after the initial visit to make sure the users had preserved the knowledge of the first session. An example of beneficial use of observation was when a core developer asked us how much the users clicked on the organization unit tree in the interface. Through observation we could reason with the developer about the change that he thought about implementing to the organization unit tree.

We expected the users to use the software in between our visits by entering data and creating reports, but this didn't always happen (ref. 8.1). Mostly it was because of the employee not having time or that there were problems with software, but it happened that we did not get a good answer as to why not. This could possibly be related to the lack of

focus on affective outcomes of the training as some users might have struggled with motivation.

The training conducted in Hue was very different from how they conducted the training at in HCMC. They did not have on-site training, but they had two training sessions over two days where users from several districts joined in. Each district sent two persons (in contrast to only one person being able to enter data in Hue (ref. 7.3.5)) for the training sessions which started with background introduction about HISP, DHIS 2, the philosophy behind HISP and the main purposes. The first session also included installation and basic usage of the system.

In the second session the users were given time to play around with the system and ask questions related to the software. When the training was over the HCMC conducted monthly phone calls to follow up, and also provided technical support only a phone call away where one of the team members would then travel to the district if requested.

At some point it would have been ideal for us to bring all users together for a session compared to the sessions that the HCMC-team used (ref. 9.1.4), but in my opinion we should have had more time the on-site training and guidance without spending time on the problems we faced (ref. 8.1).

The use of the system in Hue after we left Vietnam shows that the users that are present or do not have technical problems at their district are indeed using the system satisfactorily and regularly (ref. 8.4.1). Unfortunately, two out of four, or nine, districts is not a sufficient enough number to conclude that the rest of the users and potential users will use it.

Support function

We had limitations in Hue that they did not have in HCMC. In Hue we had no opportunity to respond quickly to a user if they were having problems because of the way the transportation worked (ref. 8.1). We did not either receive any indications of districts having problems. One user misinterpretation of the software (ref. 8.1) caused the user to stop entering data until our next visit. We did not hear about it before the following visit. If we had a support function like the one they had in HCMC where the users called the facilitators we could have solved the problem easily.

The end users and their perception

There were issues and lacking functionality when we first arrived in Hue (ref. 8.1), and there were more problems than what we could anticipate in regards to hardware and software, but the users didn't seem too affected by this.

The software is still being used and that exports are taking place (ref. 8.4.1), however it would be ideal that all districts had a stable environment for the software in all districts.

Even though it was very much still work in progress I found that the users seemed generally happy (ref. 9.6), perhaps with the exception of Huong Tra that had to battle against poor hardware, and software that didn't work (ref. 8.1) for no apparent reason.

The users did realize that this was a system that was under development and that not everything would work perfectly (ref. 8.3). They shared our frustration when things didn't work, so I don't think the issues affected them that much.

They all saw DHIS 2 as a good piece of software that would help them making reports faster, but they still refused to enter data on reports B6, B8 and B14. It's more an issue of not wanting to adapt to something new than the system not fulfilling their needs, and after recent communication with the HISP-employee in Hue it does not seem that the users will ever use the three reports until they are changed. The problem with these reports is that they are filled in horizontally on paper, whereas the standard data entry in DHIS 2 only supports vertical data entry.

Good communication between the end-user and the developer is beneficial for the project (ref. 2.4.3), and that's not possible if not the users are willing to communicate. The users all welcomed us and seemed to me very friendly, even though we were foreigners.

Facilitators and user participation

Even though DHIS 2 has been developed based on user requirements from DHIS 1 (ref. 3.2) there were still feedback from the users that were important to bring to the developers (ref. 10.3). Some of it was minor, but most of it was due to local requirements that a specification from DHIS 1 would not catch. Many of the best ideas for product improvements comes from the end-user (ref. 2.4.3), and a project like this is certainly not an exception when local requirements like the report module (ref. 7.1.4) needs to be met. The use of participatory design has therefore been highly needed in Vietnam, as it's regarded as an effective approach to overcome challenges such as changing contexts, and difficulties of capturing users' needs (ref. 2.4.1).

Since late 2005 there have almost been continuously master students from Norway in Vietnam that has been acting as facilitators during their fieldwork in relation to HISP. The roles of these students have been varied with focus on implementation, building local teams and developing the software. Their importance to the HISP-Vietnam project is unquestionable, as monitoring a project at a close distance gives realistic views of how the project is faring and what is most important to focus on.

Communication between facilitators, users and developers

The job of the facilitators in as the link between user and developer is important, but it has been troublesome and led to project failures (ref. 2.4.3) in itself. Even in Hue we had to go through two layers of intermediaries, and one huge language barrier between the user and the developer. It was a recipe for misinterpretation of user requests. Mostly it seemed to work out okay still, but it could be hard if one of the parties did not have

knowledge about the request in question. I personally did not have very good knowledge about the Vietnamese reporting system when I arrived in Hue, and it could be difficult to understand what the user actually wanted and needed if there was a request based on something the software did not support in regards to the reports.

The facilitator-role

If you take a role of a facilitator you get a different perspective on how things works than if you are a developer. In a way you take a role as an observer as you experience the way the developers or coordinators makes decisions for the end users, and you experience how the end users react to decisions made by the developers and coordinators.

At times I was frustrated with how the decision making was. One discussion about a simple thing as a menu-toggle icon went on for a week and had over 24 mails before a coordinator finally decided that the initial suggestion was okay to use, whereas in more important discussions there were lack of replies.

In October we waited for a new release to be done so that we could install that before we left for Hue. The aim was for it to be released the 25th of October, however when we left Hue in late November it was still not released. It was finally released in mid-December. This is related to the fact that the developers are flooded with tasks and have limited time to accomplish them.

11.2.1 Summary of the users, user-training and the role as a facilitator in Vietnam

In this section I will summarize my findings about the users, user training, and the role as a facilitator in the HISP-Vietnam project.

- Adequate, but perhaps inadequate user training

Even though all the users learned how to use the system, I feel it could have been advantegous to perform more training, perhaps based on the model they used in HCMC. We were time limited at the districts due to the problems we faced.

- Lacking support function in Hue

We had no support function, so the users were dependant on waiting for us to arrive at their districts before they could let us know about their problems.

- Users were generally happy and accommodating

In general the users were satisfied and we had a good relationship with them.

- The difficulties of being a facilitator

It seemed difficult to be prioritized by those in Norway, and communication was hindered some by language barriers to the Vietnamese and time difference to Norway.

11.3 Norwegians in Vietnam and their effect on the HISP-Vietnam activity

In this section I will address my research question by looking at communication within HISP before, during and after my fieldwork in Vietnam. I will base my discussion on chapter 10 in my empirical studies.

Communication and time differences

Vietnam is 8000km away from Norway and the time differences varies from five to six hours depending on the time of year. This decreased the availability of the developers, or us, when something needed to be discussed. When our working day started in Vietnam it would be in the middle of the night in Norway, and due to the time differences most communication had to be performed via mails or mailing lists (ref. 4.3.1). Instant messaging (ref. 4.3.3) would at times be the preferred method of communicating due to the communication being in real-time, but because of the time differences we had to rely more on mails. Tools like this reduce the need for face-to-face communication and greatly improve communication across borders and time zones. Frequently the time difference made it so that we had to wait to the next day before we received an answer, which can be unfortunate depending on the priority of the matter.

Differences in activity over 11 months

In the past 11 months (as of April 2007) there have been three Norwegian students in Vietnam during a four month period from late July 2006 to late November 2006. Through an analysis of the most used communication tools in HISP, the mailing lists (ref. 4.3.1) and the wiki (ref. 4.3.2) I wanted to see if there were any differences in activity in Vietnam during the fall of 2006 compared to the rest of the year.

As seen in figures 8 and 9 (ref. 10.4.3) there were a substantial increase in activity in mails related to Vietnam in August, September and November, while in October it was roughly the same as the rest of the year. Figure 14 (ref. 10.4.3) which includes every commit done during the period follows the same trend. The activity during the rest of the year fluctuates some.

All Vietnamese, and the Norwegians working with the Hue-implementation had their own status report to fill out every week (ref. 10.4.2). The updates were infrequent, and three of the developers completely stopped right before or after new years, whereas the fourth is still updating mostly every week. The Norwegians in Hue did also at some point stop updating their weekly reports before the end of their stay. It's interesting to note that there were almost no weekly status reports weeks that was skipped during the Norwegian fieldwork, and perhaps even more interesting that all weeks skipped during the fieldwork also were during the time when the Norwegians were on holiday.

Reasons for the change in activity

It's interesting to note that the Norwegians had such huge impact on the HISP-Vietnam project as it seems like they did. The activity from Vietnam in October, when the Norwegians went on a three week holiday, was roughly the same as during the rest of the year on the mailing list. This would make it seem like it was the Norwegians that were responsible for most of the activity from Vietnam. However, when looking at figure 8 (ref. 10.4.3) the Norwegians in Vietnam generally sent fewer mails than the Vietnamese, and the Vietnamese mails during October were roughly equal to the numbers in August. The decrease during the month of October can therefore be mostly related to a lot fewer mails from the coordinators and developers in Norway in conjunction with fewer mails from the Norwegians that were on holiday in Vietnam.

The discussions on the mailing lists between developers and others were typically related to administrative or technical aspects (ref. figure 12, 10.4.3) of the project which sparks more discussion than support mails. In October the Vietnamese started more threads than they did in November and August (ref. figure 11, 10.4.3), so they seemed unaffected by the departure of the Norwegians in the number of mails they did send.

The general increase in activity will mostly likely naturally be related to the implementation in Hue, and partially HCMC. At the start of the implementation there were more feedback from users as the software was not customized for Hue. The Hue report tool had not yet been finalized as it was done by the time of our departure (ref. 8.4), but as time goes and the project does not scale up as it has not done in Hue the amount of possible feedback will diminish.

Threads started by Vietnamese were mostly related to support (ref. figure 11, 10.4.3), and compared to the rest of the year there was also an increase in the amount of threads started during the time of our stay. Since the start of 2007 the number of support threads has almost completely vanished. The number of mails from the Hue-employee has also diminished severely since November 2006. 75% of all mails were written during the months of fieldwork (ref. figure 13, 10.4.3). In Hue there has not been much progress since the beginning of 2007, and the situation in HCMC is fairly stable as well. This can account for some the decrease in the support threads.

The number of total commits (ref. figure 14, 10.4.3) has remained fairly high after September compared to earlier months. There was an increase in October and November. We requested changes from Vietnam, but some can be related to seasonal changes which can explain the low numbers during the summer for example. The commits from Vietnam steadily declined from September and onwards, which seems to fit the finishing of the Hue-report tool quite well.

In regards to the wiki there may be a feeling of updating the status reports just for the sake of updating them. There were very little, mostly none, feedback in regards to the updates from the Hue-team which decreased the motivation of updating every week. This was not an official approach either, but suggested by a student (ref. 10.4.2). The lack of

activity on the wiki during the time of the Norwegians' holiday combined with the increased activity in general during the rest of the time when the Norwegians were in Vietnam seems to suggest that the Vietnamese did more when the Norwegians were close. However, with the lack of feedback the wiki seems to be not fully utilized as a tool for information updates in regards to the project. It is mostly meant as a tool for following progress, but there were core developers that did not know that we used the wiki for status reports (ref. 10.3).

I don't think there is necessarily a complicated reason as to why the difference in the activity for the whole project as seen by the total commits (ref. figure 14, 10.4.3) and the activity from the Vietnamese increases as well (ref. figure 8, 10.4.3). The eyes were on Vietnam and the goal of having a successful Vietnamese implementation for four months. Three Norwegians were sent down simultaneously which in itself was a big number. Everyone wanted to do an effort while they were there, including the Vietnamese.

It seems like after the fieldwork it all goes back to normal where the local teams take control again. We can't say that the Norwegians lose interest, but it's a lot more difficult to follow the progress from Norway than at close distance in Vietnam. The optimal activity level would be if it was possible to have the same amount of activity after the fieldwork-period as during it.

11.3.1 Summary of Norwegians in Vietnam and their effect on the HISP-Vietnam activity

Here I will summarize my findings about the effect the Norwegians had on the activity in Vietnam during their fieldwork.

- Notable differences in activity from all parties.

Everyone participated more during the time of the fieldwork. This included Vietnamese employees, developers and coordinators in Norway, and Norwegians in Vietnam, but the activity in general also declined when there were no Norwegians around in October.

- The reasons might be clear

It's natural that all parties increase their activity in relation to the specific project when three Norwegian master students travel there to join on the efforts. Everyone wants to do their part to secure a successful implementation during the limited timeframe that there is.

12. Conclusion

In this chapter I will make summarize my research objectives and make general conclusive remarks based on my discussion.

Primary research objective: *Join in on a team that wants to lay down the foundation of a successful implementation of DHIS 2 in a province in Vietnam.*

During our implementation efforts we installed DHIS 2 in four districts out of nine districts as planned. The implementation has not scaled since our departure and it has been troubled by hardware prone to errors and lack of people for data capturing causing only two districts to be functional.

I suggest that without more local commitment in terms of manpower, support and financial power there will be difficulties in scaling the system to include all nine districts which in the end will cause unsustainability.

Secondary research objective: *During the implementation process, I was a facilitator, a link between the users and the developers and I wanted to make sure the users got full support from HISP in regards to training, guidance and technical support, and to keep the developers and coordinators in Norway fully informed about the progress.*

Due to unforeseen events related to hardware and software we felt that we often had insufficient time during our visits to the districts to perform training as we had to focus on making the software and hardware work. Still we felt that every user was capable of using DHIS 2.

There seems to be a lacking support function in Hue as the visits to the districts are done when we felt we needed to visit the districts and not when the users needed help unlike in HCMC where the users could call the developers when they needed help. The users still seemed generally happy with the system.

Research question: *What are the effects on the Vietnamese team when Norwegian master students arrive in Vietnam to work together with them, and how are the communication tools in HISP utilized?*

There was a notable increase in activity from all parties on both wiki and mailing list during the time of the fieldwork, but that the reasons for the increase in activity seems logical as all eyes were on Vietnam for a period of four months.

A fieldwork of such magnitude as it was in Vietnam had positive effects on the activity for all parties included in the HISP-Vietnam project, but the activity after it seems to have declined to the same level as prior to the fieldwork.

Acronyms and abbreviations

AR	Action Research
CPV	Communist Party of Vietnam
EDS	Essential Dataset
EUT	End-User Training
DHS	District Health System
DHIS	District Health Information Software
DRV	Democratic Republic of Vietnam
GDP	Gross Domestic Product
HCMC	Ho Chi Minh City
HIS	Health Information System
HISP	Health Information System Programme
IM	Instant Messaging
IS	Information System
ICT	Information and Communication Technology
IMF	International Monetary Fund
LIC	Low Income Country
MDG	Millennium Development Goal
MISAU	Ministry of Health in Mozambique
MoH	Ministry of Health
MS	Microsoft
OSS	Open Source Software
PHC	Primary Health Care
POST	Parliamentary Office of Science and Technology
RHINO	Routine Health Information Network
RIH	Routine Health Information
RIHS	Routine Health Information System
SAP	Structural Adjustment Program
SCM	Subversion Commit Mails
SCT	Social Cognitive Theory
UiO	University of Oslo
UNICEF	The United Nation's Children Fund
WHO	World Health Organization
WTO	World Trade Organization

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Appendix A

Phase 1 - Testing and prototyping in T.P. Hue district

Time: August 7 - September 15

1. Install first release of software Monday August 14

- Minimum 1 report ready (B10)
- Pivot table with data from this year (1st, 2nd quarter imported from 1.4)

2. Provide initial on-site training

- Week Aug 14-18
- 3 visits (2 hours sessions)

3. Follow-up training

- Next 4 weeks, Aug 21- Sept 15
- 1-2 visits a week

4. Bug fixing and software improvements

- Based on user feedback (be active in retrieving feedback)

5. Seminar on health management and information use

Phase 2 - Implement software in the health service and three more districts

Time: September 15 - December 14

1. Install software in the three new offices

2. Training seminar for all 4 offices (Huong Thuy, Huong Tra, Phu Loc and Hue city)
Time: Beginning of October

- Invite users from all five offices
- 1 day training seminar

3. On-site training in all 4 offices

- Minimum 1 visit every two weeks to all four offices
- Prioritize quick response to support requests from the users

4. Bug fixing and software improvements

- Based on user feedback (be active in retrieving feedback)

Phase 3 - Scale up to include all 15 reports

December 15, 2006 - March 31, 2007

1. Migrate the remaining reports from 1.4 to 2.0
Deadline: December 15

2. Develop BIRT report templates for district and health service
Deadline: December 15

3. Extend pivot table templates to include data from new reports
Deadline: December 15

4. On-site training in the use of the new reports
Time: December 15, 2006 - January 31, 2007

- Minimum 1 visit to each office every week

5. Follow-up training at each of the four offices

- Minimum 1 visit every 3 weeks to each office

6. Seminar in health management and use of information
Time: February/March 2007

- 1 day seminar for all district managers and health service director/managers
- link this seminar to the HIS course in HCMC

Appendix B

Memorandum of Understanding

between

The Hue Province Health Department, Vietnam

and

The Health Information Systems Program (HISP), Department of Informatics, University of Oslo, Norway

Collaboration on Health Information Systems, Open Source Software development and capacity building in Hue province

Agreement

This is a Memorandum of Understanding (MoU) between the Hue Province Health Department and HISP, University of Oslo, to collaborate on developing and implementing a district based Health Information System (HIS) in Hue Province.

Outsoft, HoChiMinh City, and OutsoftHue, Hue are HISP partners in the project.

The project in Hue Province will be carried out in collaboration with a similar project in HoChiMinh City. The project in Hue Province aims to contribute to national development through collaboration with the Vietnam's Ministry of Health.

The Open Source District Health Information Software (DHIS), developed by HISP in South Africa, will be adapted and customised according to the needs and requirements of the Hue Province. The DHIS software will be implemented in all 9 district offices and in the Hue Province Health Department. The system will capture, manage and provide analysis and reports from the data reported routinely by the wards and health units to the districts. The data is reported on paper formats from the wards and health units to the district offices where it is entered in the DHIS software. From the district the data is reported to the Hue Province Health Department on electronic formats using e-mail. Data can also be reported using discs. At the Hue Provincial Department of Health the provincial database will be maintained.

The project will revise the reporting forms and integrate the information between all health programs. Today the health units are reporting similar data to several offices at district level. The aim is to integrate this fragmented reporting structure by creating a unified and integrated district database.

In addition to the routine health data the databases at district and province levels will also contain other types of data such as population and census data, and data on infrastructure and personnel.

The system is flexible and extendable. When more health units (e.g. hospitals) get computers, the software can also be implemented and used locally, and report on electronic format to the district.

The DHIS software is a tool for health managers and workers to analyse their own data and customise reports so that information can be used for planning, monitoring, management and general support of the health services.

Project organization and responsibilities

The project will be based at the Hue Province Health Department where 3 staff members will be allocated to work in the project. An engineer will be responsible at the Hue Province. In addition 2 staff members from health management: the Mother and Child Health and Preventative Health programmes will be members of the team. Integration of the information from all health programs is a priority. In each district a team of 2-3 people will be formed, one person responsible for statistics and computer and one or two from health management. The province level team is responsible for training the district teams.

The Hue Province Health Department is responsible for the technical infrastructure. The project will implement the system on the computers and network that is being planned and currently implemented in the districts in Hue Province.

Revising data standards, reporting formats and routines are important parts of the software development and implementation process. HISP will assist the Hue Province Health Department in this work.

The HISP team, consisting of OutsoftHue, TMA Solution and the University of Oslo, will develop, adapt and maintain the DHIS software and assist the Hue Department of Health in implementing the project.

The DHIS software is developed by the international HISP network and is Open Source and provided free of costs. HISP is responsible for the software and its implementation and will assist in the training and facilitation.

Training

Training and capacity development are critical components of the implementation and need to be carried out at three levels:

a) The Hue Province Health Department IT unit needs to be able to run, maintain and "trouble shoot" the system once it is implemented. This capacity will be developed by ensuring strong participation from the Hue Province Health Department in all stages of software adaptation and implementation.

b) Training of staff responsible for the system at district level. A minimum of two people from each district needs to undergo training in basic system running and maintenance as well as in managing the information, making reports etc.

c) In addition to the basic technical capacity to run the system training will also need to address analysis and use of information for management and health services delivery.

Project plan

The project will be implemented in 3 phases. At the end of each phase a more detailed plan for the next phase will be developed.

Phase 1: Pilot. 20 October 2004 – February 2005

Define and set up database based on routine reporting formats:

Revise the data sets to be used in the first database version

Organise the population / demographic data to be included in the database

Identify the key indicators to be included in the database

Define the key reports to be produced by the system

Implement the system in the Hue Province Health Department, Hue City and Huong Thuy District

Phase 2: Implementation. March – December 2005.

Implement the system in the remaining 7 Districts of Hue Province. Train all district teams.

Based on the experienced gained the software will be further developed on a continuous basis.

The aim is to get the data collection and reporting part of the system working in all districts at the end of this phase.

Phase 3: Consolidate the system and improve the use of information. January – December 2006.

This phase will focus on analysis and use of information for management and health services delivery. Health management at district and province level will be trained on how they can use the system to analyse data and make customised reports.

The staff responsible for the system in the district will be trained on analysing data and making reports.

Background: the Health Information Systems Programme (HISP)

HISP is an international research and development network. Starting in South Africa in 1994, HISP has since 1999 developed into an international network including Mozambique, Malawi, Tanzania, India and Ethiopia. Vietnam is now being included as a partner in the HISP network.

The Open Source DHIS software was first developed in South Africa and has been implemented in all districts and hospitals in that country since 1999. DHIS is now in various stages of adaptation, testing and implementation in a number of other countries. A major HISP objective is to build a strong network of Open Source Software development between developing countries. Vietnam will be an important contributor to this network.

The core research and development and 'networking' activities in HISP are funded through the Norwegian Government. In each country participating in HISP additional

funding for development, implementation and educational programmes have been obtained from various sources such as international donors and local health authorities.

Signature……Date……..
Dr. Nguyen Duc Hue, Director, Hue Province Health Department

Signature……Date……..
Associate Professor Jorn Braa, Department of Informatics, University of Oslo, Norway. Coordinator of HISP

Appendix C

Agreement between Health service of Thua Thien Hue province, OutsoftHue, and the HISP project

Background

The Health Information Systems Programme (HISP) is active in a number of countries, and is committed to facilitate the introduction of computer based information systems for reporting and analysis at the district level and below, and to enhance the use of public health care data at all levels. A major part of the project involves the development of a tried and tested open source software package called the District Health Information System (DHIS). The newest version of this software is called 1.4, and runs on a Microsoft Office platform, as that is something most health care users have access to and know. A new, Java based version is also under intense development in Vietnam and elsewhere, and will be completely platform independent and free.

The DHIS has been running in pilot phase in a limited number of health care units in Ho Chi Minh City and in Hue since end of 2004. In agreement with the health authorities in these provinces, the pilot will be expanded in the third quarter of 2005, with the aim to go into full production by the end of 2005.

Hue

As of February 2005, the DHIS 1.3 version is running as a pilot in two districts in Hue, one urban and one rural. The two districts are facing some problems, both places the database disappeared due to problems with MS Office service releases. These problems are now fixed and in both pilots the system is being improved and prepared for the next implementation phase. The health service of Thua Thien Hue is very committed in this work. In order to realize the full value of the system, this must be expanded to all 9 districts as soon as possible, transitioning to the improved 1.4 version. OutsoftHue has generously offered their technical and managerial expertise to assist in the development of both the overall public health information system for Hue province and directly with the open source software.

Responsibilities

Health service of Thua Thien Hue

Health service, in particular the statistical division, has successfully established the organizational hierarchy, essential data elements and required reports in the current version of the DHIS, and introduced it in two districts. The commitment will have to be expanded in the next phase:

- The health service will nominate a person as their project manager, to ensure progress and proper coordination with all the sites in Hue, as well as with the HISP project in other provinces and in Oslo.

- The health service will commit to hire a full time person who will take care of technical matters related to the development and running of the DHIS system and hardware. HISP will support the health service with the salary of this person and a computer. She comes from Informatics Department, Hue College of Sciences and will start working in this position from June 1st 2005.
- The health service will provide sufficiently powerful computer systems for the remaining 7 districts, including printers for the production of local reports.
- The health service will assign persons in all districts, who will be responsible for data entry, report production and training locally. These persons will be given sufficient time for training in and management of the system.

OutsoftHue

OutsoftHue have played a crucial role in the development of a computerized health care information system for Hue in the first part of the pilot phase, and will continue to be an essential partner in the next phase. Both the transition to the 1.4 version and the expansion to all 9 districts in Hue will require extensive technical and information system support to the health services.

- OutsoftHue will provide thorough training in both basic computer skills and in the DHIS system for all staff selected by the health services to work with the DHIS in all districts, and continue to provide technical support to all the districts.
- OutsoftHue will provide one full time person who will ensure the progress of the expansion of the DHIS system to all Hue districts and manage the transition to the 1.4 version. This person must go to HCMC for one week of training in the 1.4 version in April 2005.
- OutsoftHue will send one Java developer to take part in the development of the 2.0 version of DHIS with the HISP team at TMA Solutions in HCMC for a period of four months, starting in the end of February 2005.
- OutsoftHue will provide working space and internet connection for one Master student from the University of Oslo, and one student from Hue University of Science and Technology.
- OutsoftHue will provide support from a person with strong English language skills who can assist with the translation of the new version of the software, as well as other documents and act as an interpreter when the need arises. This person will also keep the http://www.hisp.info/Confluence web site updated as far as activities in Hue are concerned.
- OutsoftHue will make available all necessary GIS data for Thua Thien Hue province, to enable the reports and analysis in the DHIS system to be complemented by maps.
- OutsoftHue and the HISP project would like to collaborate on open source development. The scope of this needs to be determined, but there should be one developer assigned as responsible for the collaboration.

HISP

- HISP will provide the open source software free of charge, and commits to tailor the

next version of the software to the needs of the Thua Thien Hue Health service.

- HISP will provide training and support for the Thua Thien Hue Health service both by visits from project coordinators and postgraduate students who carry out field studies in Vietnam.
- HISP will cover the travel expenses to HCMC for the two people from OutsoftHue mentioned above.
- The HISP project will provide facilities for networking and remote support through such means as email, mailing lists and on-line documentation.
- HISP will provide advanced technical training in open source technologies and frameworks for students and developers taking part in the development of the new version.
- HISP has provided two computer systems for Hue province. These are completely under the supervision of the Health service of TT-Hue province.
- HISP will provide the salary, a computer and office equipment for the technical person working at the health service as mentioned above.

Hue, 14 March 2005

Dr. Nguyen Dung	Dr. Le Viet Dung	Ola Hodne
Titlestad		
Health Service TT-Hue	OutsoftHue	HISP, Univ.
		of Oslo

Appendix D

Agreement between Health Service of Thua Thien-Hue province, and the HISP project

Background

The Health Information Systems Programme (HISP) is active in a number of countries, and is commited to facilitate the introduction of computer based information systems for reporting and analysis at the district level and below, and to enhance the use of public health caredata at all levels. The HISP project in Hue was initiated in November 2004 and since then the software and routines for computerization have been piloted in first two districts, and then since March 2006 in five of the totally nine districts.

The HISP project provides a flexible open source software package, the DHIS, to support reporting and analysis of health information. This software has been co-developed and customized to the Vietnamese context by the HISP Vietnam teams in HCMC and Hue.

The software being used is a previous version of the DHIS; the MS Access based DHIS 1.4 and the next step in the project should be to upgrade to the newly released version 2.0. Following a successful software upgrade process the plan is to extend the project's scope to include all 15 statistical reports (B1-B15), and to involve all nine districts over the next 1,5 years. To support this expansion, the HISP Vietnam project would like to strengthen the HISP team in Hue with more technical staff. This agreement outlines how this upgrade and the expansion process will take place and how responsibilities will be shared among the two collaborating parties.

Timeline and action plan

September 15 2006:
Finish upgrade to DHIS 2, including database, reports and pivot tables for analysis. This first deliverable will include five (B1, B9, B10, B11, B12) of the 15 reports of the statistical health information system.

This system will be implemented in the five pilot districts during September. The data from the remaining four districts will be reported using the traditional paper forms from district to province and registered electronically at the province level to ensure full provincial coverage of the data (B1, B9, B10, B11, and B12).

December 15 2006:
Extend the data scope to include electronic reporting of all 15 (B1-B15) reports from the five pilot districts.

April 2007:
Extend the geographical scope to include totally seven districts.

July 2007:
Extend the geographical scope to include all nine districts.

December 2007:
All districts should by then report all 15 reports (B1-B15) electronically to the province level.

Responsibilities

TT Hue

- The health service will assign persons in all districts, who will be responsible for data entry, report production and training locally. These persons will be given sufficient time for training in and management of the system.

- The health service will provide sufficiently powerful computer systems for the remaining 4 districts, including printers for the production of local reports.

- The health service is responsible for supplying working place for Norwegian members of HISP Team in Health Service of TT Hue.

HISP

- HISP will provide the DHIS 2.0 software customized to support the T.T. Hue Health Service and the Statistical Division's HIS (B1-B15).

- HISP will continue to support running project implementation costs with a monthly contribution of 1.500.000 VND until the end of 2007.

- HISP will continue to support the salary of our employee in Hue until the end of 2007. She provides technical support to the project.

- HISP will dedicate one of the HCMC-based developers to work for the project in Hue. He will be based in HCMC and support software development from there, but visit Hue when necessary.

- Two Norwegian developers will be based in Hue from August-November 2006 to support the DHIS 2.0 upgrade process.

- The support for computerization process in the five pilot districts, HISP will provide 1 new computer and 1 printer to Nam Dong district and 1 printer to Huong Thuy district.

Dr. Nguyen Dung Dr. Duong Dinh Cong Ola Hodne Titlestad